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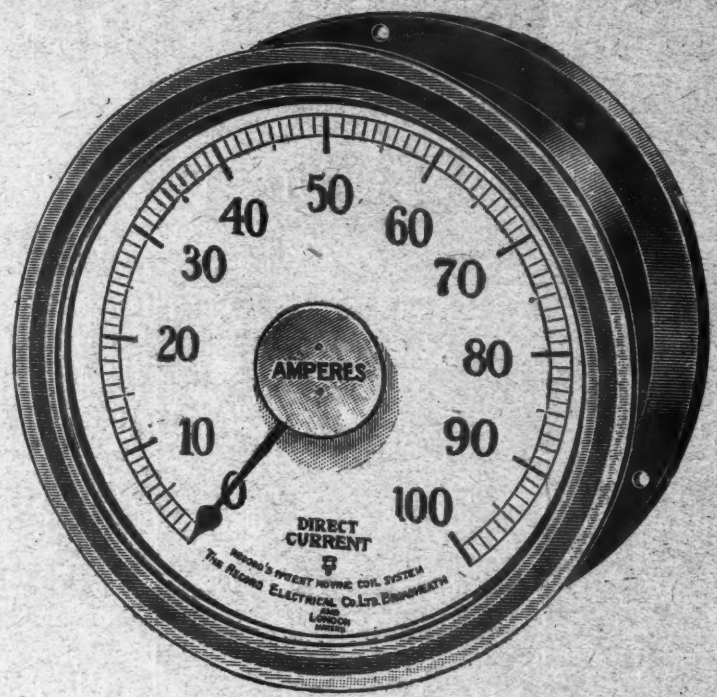

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THE

ELECTRICAL REVIEW.

VOL. LXXX. MARCH 16, 1917. No. 2,051.

ELECTRICAL REVIEW.

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CHEAPER ELECTRICITY SUPPLY.

LAST week we commented at some length upon the very successful conference which was recently held in Manchester under the ægis of the Board of Trade; in view of the importance of this event, and the fact that we publish elsewhere in this issue a lengthy report of the proceedings, we may be excused for making a further reference to it, as we wish to emphasise the remarkable unanimity which prevailed throughout the meeting, and which, we think, offers a good augury for the future. Not only at Manchester, but also at other centres where meetings of supply authorities have been held to consider the question of linking-up, the consensus of opinion has been entirely in favour of the movement, which is gathering impetus, and may now be said to be certain of accomplishment.

That the attitude of company officials would be favourable to it might readily have been foretold; but what is the cause of the enthusiasm of the representatives of municipal authorities? It seems to us to be due mainly to one thing: our municipalities have at last discovered electricity as a motive power. The position was very ably put by the Town Clerk of Blackburn, who, as he said, had practically grown up with electricity supply. He pointed out that, in the early days, electricity was looked upon merely as a means of lighting shops and the houses of the well-to-do. Now it was realised that it was the motive power *par excellence*, and that a cheap and reliable supply of electricity was absolutely indispensable to the prosperity of our industries. There is the answer in a nutshell. Of course, no electrical engineer needed to be told that that was so; the great thing is that it is now becoming understood by the laymen, and for this we have to thank the world-war, which in so many ways is opening the eyes of our fellow-countrymen to facts to which they had been blind. And therein lies the guarantee that the movement towards cheapening and extending the supply of electricity will attain fruition.

Now, we wish to point out that linking-up is not the beginning and end of the matter. It involves wider issues, which ought not to be neglected at a time when they are likely to be accorded favourable consideration. One of the most important of these is the perennial question of wayleaves. So long as owners of land, both private and public, are permitted to hamper and delay the development of supply networks, in opposition to the common welfare, so long will it be impossible to attain that degree of efficiency and economy which is imperatively necessary in the interests of the nation. The article which we recently printed, from the pen of one who is intimately acquainted with the conditions that are met with in practice, gave numerous instances of wilful obstruction which ought to be made impossible. Besides hindering progress in connection with the larger undertakings, these practices present formidable, if not insurmountable, obstacles to the extension of electricity supply to the smaller townships and villages, and to dwellers in rural areas; and this brings us to our next point.

The Kaiser boastfully, but prematurely, declared that the future of Germany lay "on the water"; it would be true to say that ours lies not only on the water, but also on the land, as we may have good reason to know during the coming months. The uses of electricity in agriculture, both for motive power and for intensive cultivation, have for many years past occupied a prominent position in our pages, and we have missed no opportunity of impressing their importance on our readers. The present circumstances lend added weight to the demand that every effort should be made to enable farmers to avail themselves of the advantages of electric power and electroculture, and we are glad to know that the Board of Agriculture is instituting experiments in connection with the latter on a large scale in Herefordshire. In 1915 we gave an account of the excellent progress which had been made by Mr. Kerr, the city electrical engineer of Hereford, in promoting the use of electric power, and he subsequently read a paper before the Municipal Electrical Association on the subject which was regarded as marking an epoch in its history. Quite recently the work at Hereford has acquired some prominence in the lay Press, and an extraordinary amount of interest has been aroused in the possibilities of electroculture for stimulating the growth of plants. But until the movement towards interconnection has solved the wayleave problem, the extension of electricity supply into rural areas, to bring it to the door of the farmer and the villager, can make but little progress. Thus the questions of linking-up, wayleaves, village lighting, and assisting agriculture are all intimately associated, and to some extent interdependent.

Now, these subjects—wayleaves, agriculture, and the like—are pre-eminently matters which ought to commend themselves to the attention of such bodies as the I.E.E. and the I.M.E.A., and we are glad to know that both these Societies are moving to good purpose. The discussion on wayleaves which is to take place at the Institution on April 12th should prove fruitful in bringing this question to a head—Government action is urgently needed—and we trust that the members will seize this opportunity of voicing the feeling of the electrical profession on this point. With regard to agriculture, it is permissible to state that vigorous action is being taken, of which more will soon be heard. Hence, we hope the activity which has lately been manifest in the quondam Sleepy Hollows of British electricity supply undertakings may soon transform the situation, and bring us appreciably nearer to that era which was so ably foreshadowed by Dr. Ferranti in his famous presidential address, when electrical energy shall be available everywhere, for every purpose, at a trifling cost.

Industrial Federation.

We publish on another page an abstract of the speech delivered by Mr. Dudley Docker at the first general meeting of the Federation of British Industries. It will be observed that those who are interested in the development of the organisation are proceeding cautiously in order that they may learn as they go what are the safest and soundest principles and policies to pursue and to adopt in order that the Federation may adequately represent the true interests of our national industries considered as a whole. It is felt that to fill in the details of the scheme at too early a stage may defeat the grand object that is in view; and while, as we said last week, we are anxious to see the completion of a great organisation which will be capable of meeting the after-the-war industrial situation immediately that situation confronts us, we can see the wisdom of proceeding *slowly* if by doing so we are advancing *surely* in such a way that there will have to be no capitulations, or time and energy wasting retreats, as the result of false steps. It is perfectly true that the movement is a great experiment for us in this country, and that all sorts of new factors may come into play at any moment which may have a very definite effect upon future course of action, also that important and desirable interests might be excluded by too precipitate a formulation of policy. The Federation is being strengthened as an Employers' organisation by the accession of, and by co-operative working with, several other associations; we do not want too many bodies with similar objects and aims. It is also stated that the Engineering Employers' Federation will work in co-operation with the F.B.I., but, so far as our information goes, the entire engineering interests of the nation are still in need of co-ordination in order that they may take their proper place in relation to a super-organisation. The Federation is to be congratulated on the efforts that it has made to secure that better atmosphere for the co-operative working of Capital and Labour, which is so essential for the future if we are to be saved from catastrophe. Labour consists of many sections, with many ideals, and we should like to feel that its organisations were making headway with their own efforts at co-ordination, so that there might be a truly representative voice to be heard when matters come to be deliberated upon. But no doubt on that side, too, the need for proceeding cautiously is recognised, for the factors in the situation as it may develop cannot be foreseen. The objects of certain sections of Labour have been drawn up in resolution form on several occasions, but owing to the changing state of affairs due to the increasingly heavy demands made by the war the value of these as a basis for negotiation becomes lessened as time goes on. The Prime Minister has referred the Labour Party's last resolutions to the new Reconstruction Committee. There will come a time when demands which will form the read basis for deliberations will be presented; and Federated Employers may then find it necessary to make known the details of the policy for which they stand. We must expect the demands of Labour to be large; the work of negotiation will be serious and arduous, calling, as Mr. Docker says, for all the patience, tact, and consideration at command; extravagance on the one side, or obduracy on the other, will not help the situation when it comes; earnestly do we all need to strive for an after-the-war spirit of Peace within ourselves. In the meantime, however, serious efforts should proceed unremittingly on both sides to secure a continuation of atmosphere in which harmonious relations may be cultivated.

Catalogues: Notice to Manufacturers.

The Order relating to catalogues comes into force on March 24th, its operation having been deferred a fortnight to allow those having stocks to make immediate use of them. In future it will not be permissible to send catalogues and price lists "through the post or otherwise" unless a request for the delivery of same has been made in writing. As stated in our pages last week, the sending of catalogues, &c., by traders to traders for the purpose of their trade, or to persons abroad, is to be permitted, but there are electrical and engineering people in this country who, though not traders, should, in our opinion, in the interests of munition manufacturing and of export trade, be kept acquainted with new descriptive technical and trade literature. We shall be glad, under these circumstances, if electrical and allied manufacturers and traders who have been in the habit of forwarding us their publicity literature for notice in our pages will kindly send us particulars of the new catalogues, &c., that they may issue, or contemplate issuing, so that we may keep the trade informed of their doings.

SOME LONG-DISTANCE WIRELESS STATIONS.

In recent issues, the *Wireless World* has published descriptions of several famous long-distance wireless stations which have helped to make history during the war, and by the courtesy of the Editor we are enabled to reproduce some of the interesting views and particulars there given. Fig. 1 shows the interior of the United States station at Arlington, which takes the place in America of the Eiffel Tower in Europe, in that it radiates time signals and other official information. It is the property of the United States Government, and is situated near Washington, on a site of 13½ acres. Fig. 3 shows the three steel towers which support the aerials, the centre tower being 600 ft. in height and the other two, which form with it an isosceles triangle, 450 ft. high; the base of the triangle is 350 ft. long. The steelwork is insulated from the ground, and in the case of the largest tower weighs 500 tons, whilst the other towers weigh 275 tons each. Three-phase alternating current at 25 cycles is supplied to the station at 6,600 volts, and is stepped down to 220 volts for delivery to the three transmitters; one of these is the 100-kw. Fessenden spark

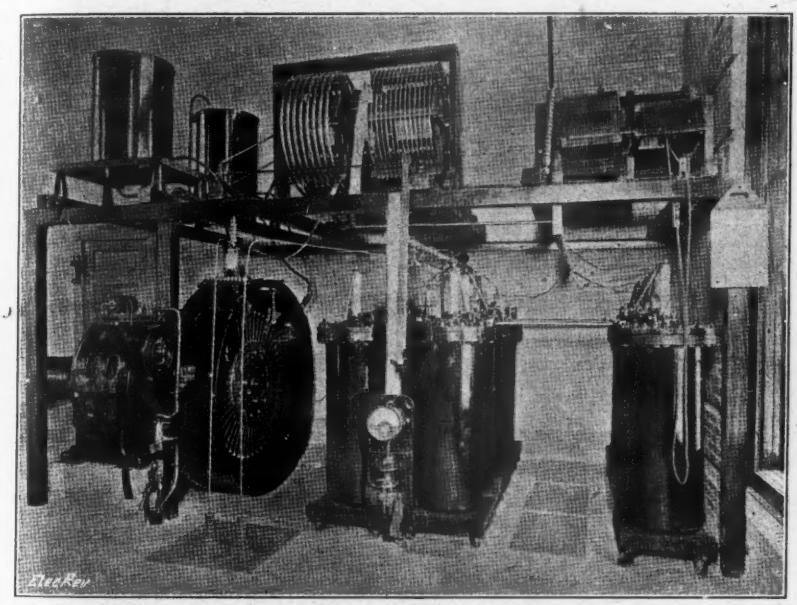

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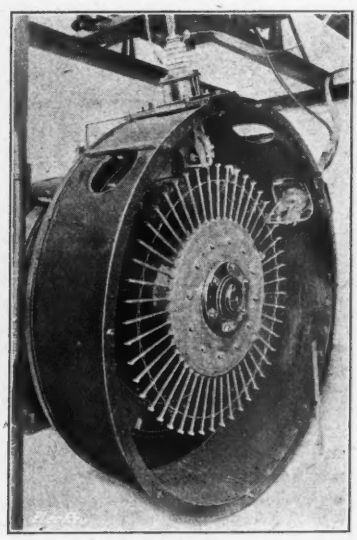
Fig. 1.—100-kw. Spark Transmitter at Arlington.



[Buck, Washington.

Fig. 2.—Rotary Discharger.

set illustrated in fig. 1, another a Poulsen continuous-wave 100-kw. set, and the third a 5-kw. spark set supplied by the Wireless Improvement Co. The first-named set is very similar to the Marconi type, and employs several of the Marconi patents; in the illustration, the alternator and rotary spark-gap are shown on the left, the condenser banks in the centre and on the right-hand side, and the primary and secondary of the jigger above. The transformer is situated beneath the floor, the high-pressure leads being seen in the foreground. The plant is driven by a Westinghouse 200-h.p., 220-volt synchronous motor, at 300 r.p.m., which is coupled to an 8-kw. d.c. generator, which excites the fields of the driving motor and the 100-kw. alternator, a General Electric machine operating at 220 volts, 500 cycles per second, at 1,250 r.p.m. The rotary spark-gap (fig. 2) is attached to the framework of the alternator, the rotary portion being mounted on the main shaft. The rotor consists of a fibre wheel with a heavy brass ring on its periphery, from which protrude 48 copper electrodes, each about 10 in. long. Water is circulated through the stationary electrodes from tanks on the framework above. Phase adjustment with the spark-gap is effected by rotating the casing. One lead from the alternator runs to the primary of the transformer direct, the other through a large relay key, which is shunted by a resistance, so that instead of completely breaking the circuit, the key cuts the resistance out and into circuit, reducing the sparking and wear on the contacts. The relay key is controlled by a small sending key, which operates an electromagnetic mechanism. The secondary leads from the transformer go to the stationary electrodes, across which are shunted the condensers and the primary inductance of the jigger. The condensers are of the compressed-air type, each consisting of a large cylindrical metal tank, in which the plates are suspended from insulators; the plates are spaced ⅛ in. apart, and the air is raised to a pressure of 250 lb. per sq. in. An external safety gap is set to a distance slightly greater than the gap between the plates, and the current is turned on intermittently, allowing sparking to take place inside, until the small particles of dust in the air are burned out, after which the spark jumps across the safety gap; the latter is then lengthened, and the process repeated until the safety gap is 1 in. in length. Each condenser has a capacity of 0·036 microfarad, and there are 14 units, connected seven in parallel and two in series. The oscillation transformer or jigger is made of copper tubing in helices about 4 ft. in diameter, the primary having eight turns and the secondary 16. The connections are shown in fig. 4, p. 284.

The aerial is made up of three sections, with 23 wires in each section, each wire consisting of seven strands of No. 20 gauge, of phosphor-bronze. These wires are attached to spreaders 88 ft. long, the spreaders themselves being attached to the towers by 10 Electrose insulators. The aerial is open at the highest end (at the 600-ft. tower); two sections are brought down to the 450-ft. towers, and two joined to the main section by "jumpers" made up of 23 wires bunched in the form of a rope. The main section is what is known as a "T" antenna, and the vertical part is taken from the middle. The 23 wires are brought down in the shape of a fan for 300 ft., and then in the form of a large cage the rest of the way to a switch at the base of the tall mast.

The ground connections consist of many lengths of wire buried in the ground at various depths in the space near the towers, and led in a "draught-board" pattern with soldered junctions. Many miles of wire were laid in making the large network, and, finally, wire leads were run down the slopes, ending in a small stream that flows near by. The ground connection between the aerial and this network is through a large copper strip 6 in. wide and ¼ in. thick.

For the description of the Arlington station our contemporary has drawn from a paper presented to the Washington Section of the Institute of Radio Engineers, by Capt. William H. G. Bullard, U.S.N., until recently Superintendent of the United States Naval Radio Service.

The Nauen station of the Telefunken Co., which is situated near Berlin, is also described in the *Wireless World*;

it works in conjunction with the U.S. station at Sayville, and has a central mast 900 ft. high. From this station Germany hoped to maintain communication with her colonies, and early in 1914 it was proved that messages could be transmitted to Togoland, which could in turn communicate with German South-West and East Africa. The central tower is surrounded by five shorter masts (fig. 5),

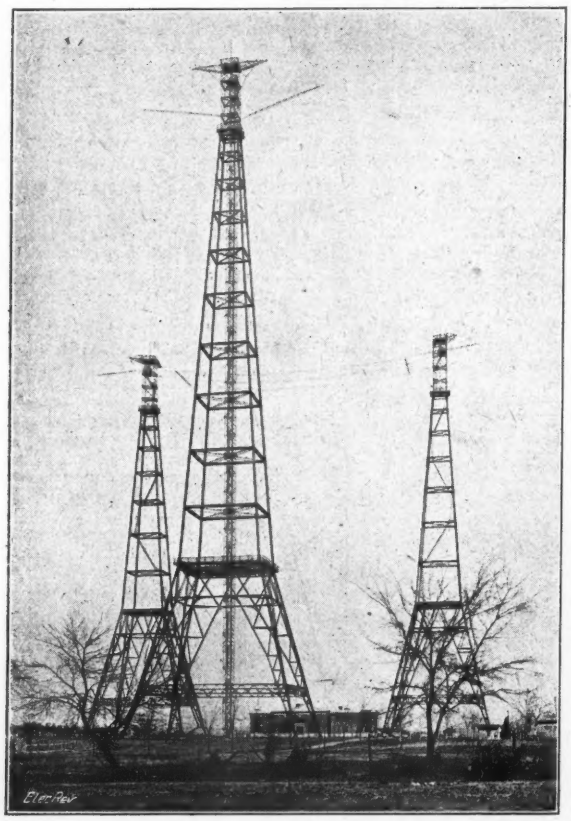
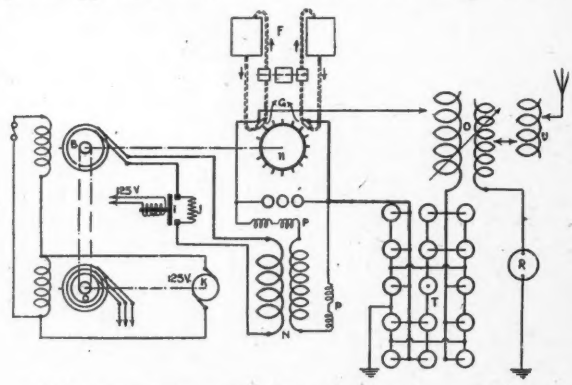


Photo. by] *[Buck, Washington.*

FIG. 3.—ARLINGTON ANTENNA TOWERS.

and is mounted on a single steel ball resting on a slab of marble, which provides the necessary insulation, the tower being kept in place entirely by numerous stays. An earlier tower, 600 ft. high, was brought down in a gale some years ago. A very extensive earth system is provided, consisting of many miles of wire embedded in the ground. The antenna is of the double inverted L type. The plant comprises apparatus of both continuous-wave and quenched-



B, single-phase generator; D, three-phase motor; K, exciter; I, relay key; J, resistance; N, transformer; P, choke coils; H, discharger; G, stationary electrodes; F, tanks; T, condensers; O, oscillation transformer; U, aerial tuning inductance; R, hot-wire ammeter.

FIG. 4.—DIAGRAM OF CONNECTIONS OF 100-KW. TRANSMITTER.

spark type, the former being of 250-KW. capacity at 8,000 cycles per second, with a Joly frequency multiplier. Fig. 6 shows the base of the central tower. The long-distance station at Dar-es-Salaam, in German East Africa, was constructed on the same principle, but was wrecked by the enemy before the British troops took possession of the station.

Passing to the Pacific side of the American Continent, the wireless service between the United States and Japan claims notice. This was inaugurated four months ago; it bridges a distance of 4,200 miles between San Francisco and Funabashi, with a high-power relay station at Honolulu —but direct communication between the terminal stations

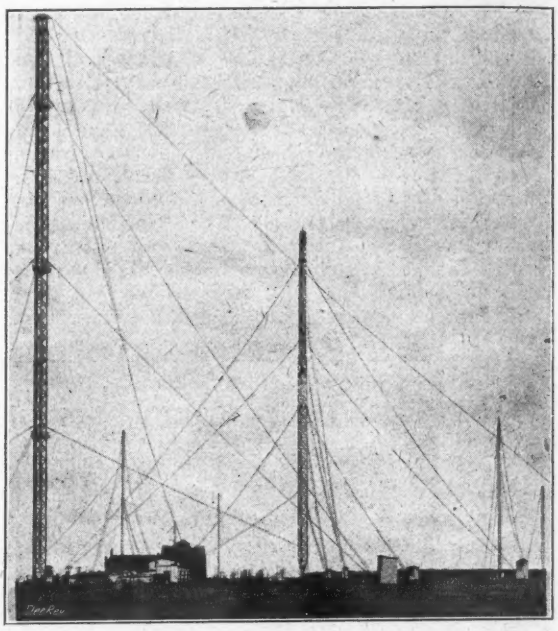


Photo. by] *[Giles Photo. Agency.*

FIG. 5.—WIRELESS STATION AT NAUEN.

is possible under favourable conditions. Here the Marconi system is employed, the American Marconi Co. being the manufacturers. The service forms part of a wider scheme,

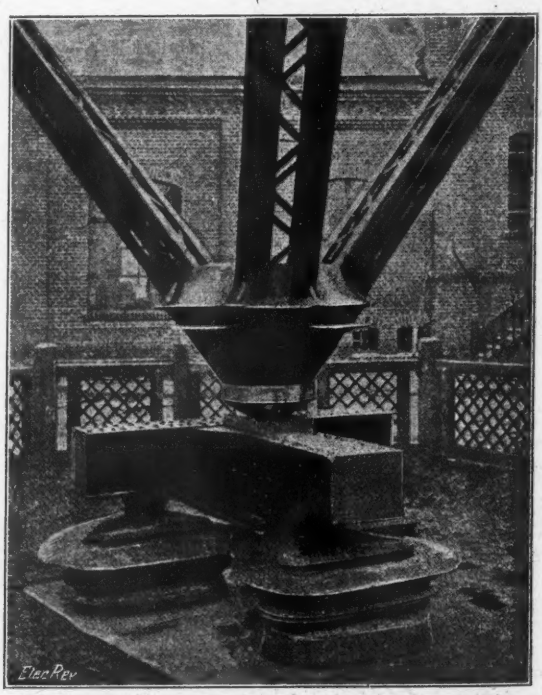


FIG. 6.—NAUEN: BASE OF 900-FT. TOWER.

embracing stations at New Brunswick and Belmar, on the New Jersey Coast, to communicate with corresponding

stations in Great Britain ; stations at Bolinas and Marshall, in California, communicating with the Hawaiian stations of Kahuku and Koko Head ; stations at Manila, in the Philippine Islands, and stations at Marion and Chatham, Mass., communicating with Stavanger and Naerbo, in Norway.

From the operating house at Koko Head as a centre, the San Francisco aerial extends south-westward, and is carried on five 330-ft. masts to an anchorage. The Japan aerial extends from the operating house almost due east. The first two masts are of the standard sectional type, 430 ft. in height, the first being on level ground and the second on a hillside. From the latter point the aerial makes a span of more than 2,000 ft. to the top edge of Koko Head, an extinct volcano at an elevation of 1,194 ft. above the sea level ; here there was not room enough to erect a sectional mast, only about 40 sq. ft. being available for a self-supporting structural tower, 150 ft. in height. The tail-end anchorage is far down on the inside of the crater. The balancing aerial, which is employed in both sets of antennæ, is on self-supporting towers, each of which is 100 ft. in height.

The station at Kahuku is now being employed both as a sending and receiving station, and is the largest wireless station in the world. From the power house, the San

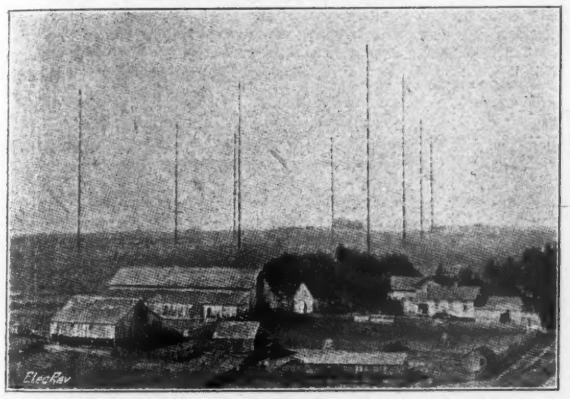


Fig. 7.—Wireless Station at Bolinas, California.

Francisco transmitting aerial extends south-westward, supported by 12 masts, each of which is 325 ft. in height ; the Japanese aerial extends to the south-east, supported by 12 masts, each 475 ft. in height.

The sending station at Bolinas, Cal., employs eight masts, each 325 ft. in height, and is illustrated in fig. 7. The receiving station is at Marshall, 12 miles to the north of Bolinas.

Automatic sending and receiving apparatus plays an important part in wireless communication between the Occident and the Orient. The sending machine somewhat resembles a typewriter, and will make possible the transmission of more than 100 words a minute. Under the automatic system, 10 or 100 messages can be filed at the same time at the office of the Marconi Co. in Honolulu. They will be distributed among the necessary number of operators, and the dots and dashes punched in a paper tape by a machine. This tape is fed into an automatic sender, and the signals are conveyed by land line to Kahuku, where the dots and dashes actuate a high-power sending key, automatically energising the aerial simultaneously with the feeding of the tape in the station 30 miles or more away. At the transmitting station the signalling currents operate the magnets of the high-power sending key in the main circuit, and the signals are flashed to the point which the destination of the message calls for, either Marshall or Funabashi. If the message is destined for Marshall it will be received on a specially-constructed Dictaphone machine, each cylinder, as soon as it is filled, being handed to an operator, who will transcribe it into a type-written message by means of a Dictaphone machine running at normal speed.

The distance from California to Honolulu is 2,087 miles, and from Honolulu to Tokio 4,140 miles.

THE CONTROLLER DRUM.

By PERCY H. JACKSON.

It has been the practice of several controller manufacturers in this country and abroad to arrange controller drums in such a manner that the resistance step contacts and their corresponding contact fingers are smaller than the line and armature contacts. This is obviously incorrect, and the following goes to show the practice to be absolutely illogical.

Take, for example, a controller suitable for use with a 35-H.P., 230-volt, series motor, the latter being provided with commutating poles, and the electrical particulars being as follows :—

Armature resistance	0·0465 ohm
Resistance of commutating pole windings...	0·0123 ohm
Resistance of series field windings	0·0455 ohm
Full-load current	126 amps.
H.P.	35
Voltage	230

Now, a controller suitable for such a machine would probably be provided with six positions—*i.e.*, five resistance steps. Assuming that the controller has to be of such capacity as to be capable of starting the motor against a torque equal to full-load running torque, the resistance would be arranged as follows :—

Position No.	Current.		Resistance in circuit.
1	70 amperes		3·3 ohms
2	126 ,,	Motor running.	1·82 ,,
3	126 ,,		·90 ,,
4	126 ,,		·440 ,,
5	126 ,,		·215 ,,
6	126 ,,		·1043 ,,
			= Resistance of motor.

It will be noted that a current of 70 amperes only is allowed to pass on the first position of the controller ; the full-load current—viz., 126 amperes—is allowed to pass on the second position, the idea of this being to reduce (so far as is reasonably permissible) the current which finally has to be broken by the controller. This is in accordance with standard practice.

Tests carried out on a controller of this description show that when passing from the "full on" to the "off" position,

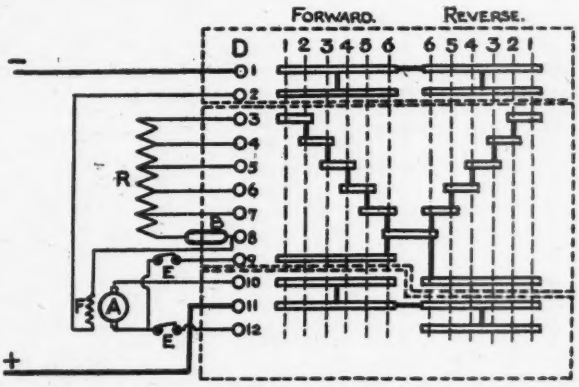


Fig. 1.—A, Motor armature ; B, Magnetic blow-out coil ; D, Contact fingers ; E, Limit switches ; F, Series windings ; R, Starting resistance.

the current falls in steps of about 15 amperes each, the current which finally has to be broken by the controller being about 52 amperes.

Diagrammatically, the controller would be designed as in fig. 1, the main and armature contacts being, for example, 1 in. in width, while, as above stated, some manufacturers would probably supply the resistance contacts $\frac{3}{4}$ in. wide. It will be noticed (see fig. 1) that six breaking points are provided. In other words, the current of 52 amperes is broken by six contacts having a total contact surface, at the moment of breaking, of 6 in., or about 1 in. to every 8·7 amperes, whereas each of the resistance contacts has to break 15 amperes on a contact surface of $\frac{3}{4}$ in. It is, of course, appreciated that the resistance contacts do not have

to break circuit absolutely as do the main contacts, but nevertheless, the absurdity of providing resistance contacts narrower than the main contacts is at once realised. Controller designers in general would do well to drop this practice, and make the resistance contacts as wide as, if not wider than, the main and armature contacts.

INTERCONNECTION OF LANCASHIRE AND CHESHIRE ELECTRICITY SUPPLY SYSTEMS.

At the conference which took place at Manchester, on March 2nd, Mr. G. H. Roberts, M.P., Parliamentary Secretary of the Board of Trade, said that there was no one now but acknowledged that cheap and ample supplies of electricity were absolutely essential to national development; therefore, the conference was one of vital importance, not only to local authorities and the companies represented, but to the nation as a whole. Economical production should be the first aim of everybody engaged in industry. It should also be the first concern of every citizen. The circumstances at the moment were not very favourable to large projects; owing to the war, the Ministry of Munitions had to exercise a tight control over metals, and over things that were necessary for the purposes of munitions, and they were aware of the extreme difficulty of raising capital. But, although these adverse elements were present, that was no reason why they should simply rest on their oars. A cheap supply of electricity was really essential to the recuperation of the nation and the great expansion that, they hoped, would be embarked upon when peace was re-established. Since he had been at the Board of Trade, they had realised the real importance of the problems that they were to consider that day. The policy pursued in the past had not been the right one; they had been too parochial in their view. Local authorities had come to regard themselves as detached entities, whereas the local authority in the future must consider itself in relation to all the authorities surrounding it. It might well happen, with the spreading of the citizen-spirit in the broad national sense, that whenever these undertakings in the future were to be embarked upon, it would not be by a small local authority, but by groups of local authorities having common purposes and seeking to serve the common interest. In so far as legislation might be necessary, the Board of Trade was willing sympathetically to consider the necessity and to advise Parliament to enact what might be essential to carry out the scheme for the economical production of electricity.

Mr. S. L. Pearce (City Electrical Engineer, Manchester, and Chairman of the Interconnection Committee), speaking as chairman of the committee of engineers who had been responsible for the preparation of the report on interconnecting the various supply undertakings in Lancashire and Cheshire, said that the letter of May 25th, 1916, which was issued by the Board of Trade, endorsed the action which had been taken in Lancashire some few weeks previously. The letter emphasised the saving in coal, but the committee of engineers would go further, and point out that there were advantages accruing from such a scheme of interconnection other than the saving of fuel. They could be summed up as follows: If fuel costs and labour costs and capital charges were to be kept down to an absolute minimum, some system of interconnecting was absolutely essential. To enable those advantages to be obtained, what was required was the establishment of a main interconnected power distribution system linking-up the several power stations in that area of Lancashire and Cheshire, very much on the lines adopted in the North-Eastern Counties. The final finding of the committee was to the effect that basing the price of coal at 17s. 6d. per ton, and on a capital expenditure of some £281,000 required for the necessary interconnecting mains and transforming plant, there would be an annual saving on coal alone of some £82,000 per annum, arising simply and solely from the more efficient use of existing plants. That this figure could be materially increased, possibly threefold, if the present-day export value of coal were taken, would be obvious. Under Section 8 of the 1909 Electric Lighting Act, the Board of Trade, with the concurrence of the Local Government Board, had power to set up joint boards of local authorities for the express purpose of jointly exercising powers conferred by the Electric Lighting Acts on two or more local authorities, where the joint exercise of those powers appeared to be expedient and desirable, and a practical example existed in the Joint Tramways and Electricity Board of the Stalybridge, Hyde, Dukinfield and Mossley Corporations. This section of the Act did not admit of companies being represented on such a joint board, and he thought it was very doubtful whether any legislation could be set up which would admit of a joint authority comprising both municipalities and power companies. The committee considered that the co-operation of the large power companies was essential to the success of the scheme, if it was to be carried out on really broad national lines, and had suggested in the report one way out of the difficulty, which would be to empower the duly constituted joint board of local authorities to enter into working arrangements with the power companies to enable them to connect up with the power companies' undertakings, and for the use of the power companies' existing mains, and for any other arrangement that might be considered good in the view of the board. The powers which the committee considered should be entrusted to this joint board when once it was set up were given in the report. The first power was to raise capital from time to time for the provision of mains, transformers, and other works that might be required for interconnecting purposes, and to allocate all expenditure on the joint scheme on an equitable basis between the undertakings participating in the scheme. The second power was to adjust running hours of the existing generating stations, in such a way that the maximum economy of fuel might be effected. This would entail the shutting down of certain stations during the night or week-ends, or times of light load, the supply being furnished by stations provided with more economical plant. The third was to lay down rules for determining the charges for supplies. The fourth was to act in an advisory capacity with regard to all future extensions of generating plant, and to advise in which localities those extensions could be best made. The fifth was to appoint from time to time such officials as might be necessary to act in an advisory capacity to the board. The second power, namely, the question of adjusting the running hours of the existing plants in the existing stations, in the view of the committee was most important, and involved an element of control. The committee felt that if the best was to be got out of the existing plant and the existing stations, some power of control must be exercised. The existing stations should not be free to run their plant just as they chose, otherwise they would be maintaining probably the *status quo* and would not be getting the best from the most economical plants. With regard to the fourth power, the committee felt that all it could do, if its advice was asked, was to state where, in its opinion, having regard to all the local circumstances of the situation, extensions of plant could be best and most economically put down. If the Board looked favourably upon the main proposals and the main principles involved, the committee did not consider that the difficulties would be insuperable, given a spirit of co-operation and goodwill, and the idea to do the best that was possible for the country as a whole. Everyone would agree as to the desirability of any such scheme going forward on a voluntary basis, and that there should not, if possible, be any suggestion of compulsion or of coercion. The committee also was very firmly of opinion that the control of the electricity supply in that part of the country should be in the hands of those most closely connected with the several undertakings concerned, who were, he thought, in a position to understand the requirements of the district and the area covered by the scheme. A most important point was that the statutory powers of the several undertakings mentioned in the report, exercisable in their respective areas, were not in any way interfered with by any of the proposals contained in the report. The view might be advanced that the same end could be attained by private arrangement; the opportunity for private arrangements existed for a very long time, and, comparatively speaking, not very much had been done in that part of the country. The committee considered it to be far preferable to set up a joint board whose engineering advisers would have constantly before them well-thought-out plans for co-ordinating the whole of the electricity supply undertakings of the Lancashire and Cheshire area. To have a scheme formulated in the joint interests of all, to be carried out a stage at a time, if desired, appeared to be a better plan than to continue the present somewhat haphazard private arrangements which frequently did not take a sufficiently long view into the future. Meetings of the several groups had already taken place for the purpose of considering the report, and a joint meeting of the first four groups had been held, and the representatives of the various local authorities and power companies had approved, practically unanimously, the main principle set forth in the report, namely, the principle of interconnection, but they reserved, and rightly reserved, their final approval of the engineers' proposals until they had had an opportunity of fully working out a detailed scheme. The whole essence of the scheme was cheap electrical power for industrial purposes.

Coun. Dagnall (Chairman of the Manchester Corporation Electricity Committee) said that the report had been under the consideration of the Manchester electricity undertaking, which had given it unqualified approval. Although the Manchester undertaking did not hope to be very considerable gainers by this scheme, there was a possibility that they might be ultimately gainers, and certainly they would be able to help those who were perhaps in a less fortunate position.

Mr. L. C. Evans (Town Clerk of Salford) said they were there to see how they could for some purposes get rid of municipal frontiers. That had been a somewhat difficult question between Manchester and Salford. They in Salford desired to preserve local autonomy for those subjects which were properly the subject of local administration, but they did desire co-operation outside their own frontiers with other local authorities in matters which ought not to regard municipal frontiers, and that was the attitude of mind which they brought to bear upon this question. It was difficult, however, to determine how to settle the exact details of such

co-operation. Each of the constituent entities in the separate groups would be one undertaking. That, of course, would raise very difficult questions. Their friends in Manchester might possibly object to their separate electricity undertaking being merged into another undertaking upon which they only had representation, and possibly the smaller authorities included in the group might object to be part of an undertaking of which they were only a very small part. That day, therefore, a much more modest proposal was put forward. It was a proposal to secure co-operation. On that basis Salford was quite prepared, subject to the details being satisfactory, to join hands with all the other authorities. It was a basis upon which they considered there should be a desire between local authorities to preserve local autonomy for matters which could better be settled parochially, but, at the same time, to secure co-operation in regard to matters which lay outside their own frontiers and which could best be done by a joint board. It seemed to him desirable to admit the principle of a joint board or a joint committee for interconnecting the electricity undertakings, and to refer the matter to a committee to confer with the Local Government Board and the Board of Trade as to the precise details for carrying it out. Beyond that they could scarcely go that day.

The Chairman (Mr. G. H. Roberts) remarked that there were 42 electricity supply undertakings represented there by 125 delegates. That intimation would acquaint the district and the country with the very great importance of the conference.

Coun. Robinson (Stretford U.D.C.) said that the old basic principle of producing the largest volume in the shortest time at the lowest cost must ever be with them as leaders of industry. He thought the principle that they were to settle that day was that municipal boundaries should not be a bar to electricity development. With that principle he thought they would all agree, Mr. Pearce having explicitly stated that in the development of the scheme the rights of each local authority would be respected and their obligations remembered, and that it meant the building up of all and the destruction of none. He was interested in a scheme at the moment where 1,500 kw. was required to drive a mill. They were seriously considering whether the public supply authorities could supply that current cheaper than they could make it themselves. If the local authorities could do that, they could imagine what the saving would be to him from the point of view of capital outlay. Looking round those areas, and reviewing the enormous industrial interests involved and the prospective developments, if they could just reach that ideal of production which would enable a collective production to supply the units at a lower price than the separate entities could make it among themselves, the saving of capital outlay to the industries of the country would be enormous. Stretford would give this scheme its hearty support. The spirit in which the engineers had approached the question had made it possible for it to be considered on a purely economic basis apart from the municipal boundaries.

Dr. H. F. Parshall (Chairman, Lancashire Electric Power Co.) said the position of his company so far as linking-up was concerned was such that it almost automatically subscribed to the proposals or suggestions of the committee, because in the five instances given, most of them had been carried out or were in the way of being carried out, and there was no particular difficulty either from a financial or engineering point of view in carrying out the balance. So far as the company was concerned, it was quite agreeable that all its facilities should be utilised by the different local authorities and the companies it was associated with. Speaking broadly, it was really in the position of having already done what it was proposed to do on a much larger scale. The proposal to have the whole matter most broadly dealt with by the Board of Trade was the one that in the final result would lead to the greatest economies. If their own installation was not in accordance with the general economic principles governing the cheapest electricity supply, they were willing to stand by the decision of the central tribunal, and await its findings, and loyally carry out all the rules and regulations and provisions of a central committee to determine which installations should go or what the general procedure should be. If England were divided up into districts, and each district was examined from the standpoint of economic supply, and that district as a whole was accountable to a Parliamentary authority, or authority constituted by Parliament, and there was a system of inspection by the Government, or headquarters, so that the economic supply of a particular district could not be hindered—if such a body could be constituted without fear or prejudice, and be able to say, "In such and such a district such and such things have to occur," if that should be the position, then he would recognise it as ideal. That was the position that his company was prepared to stand by loyally and well.

Coun. Jamieson (Chairman of the Electricity Committee of the Bury Corporation) said that this had been a pet scheme of their electrical engineer for many years, and he had never forgotten to keep his committee well posted. His committee approved of the principle altogether. The vital part was the cheapness, and also the effect the scheme would have in saving money. In B group in five years they would save £150,000 of capital, and in the first year after they were coupled up they would save 30,000 tons of coal, and at the end of five years about 51,000. He hoped there would be no interfering with those committees which had got statutory powers. As regarded the large numbers of consumers to be supplied by joining up and pooling together, his committee thought it would be one of the best things that could happen from the point of economy. They in Bury had applications from a great many important industries. They could not supply them, and could not get any money from the Government to enable them to enlarge their undertaking. Therefore, his committee was anxious that something should be done, and that it should get coupled up before next winter.

Coun. E. Bury (Stalybridge Corporation), speaking on behalf of Group C, took up the position that the report demonstrated that the scheme was feasible, practical, and economical. The supply of cheap electrical energy having become such a vital necessity, as municipal representatives they felt that their resources should be organised on a much wider basis than the municipal unit. The supply of electrical energy by reason of its nature was an extremely favourable object for co-operative effort over a very wide area, and it was of the highest importance that the generation of electrical energy should be organised on the most economical lines so as to get the cheapest possible supply. There were few stations which were not refusing customers because they dared not take on more load, yet there were thousands of kilowatts of reserve plant in all the stations which could be combined if assistance from neighbours could be relied upon in case of emergency. They therefore thought that, in the national interest, this scheme should be pressed forward, and with regard to whatever legislative enactments might be required, they asked the Board of Trade to assist them to make the scheme effective. He represented a linked-up scheme on a small scale which was yielding most excellent results. The four towns of Hyde, Stalybridge, Dukinfield, and Mossley formed a joint board, and had only one interest in common —an abundant, reliable, and cheap supply of electrical energy. The board worked solely with that end in view. They considered that, after making the undertaking commercially sound, the greatest service they could render to the community was to give it a cheap supply of energy, and not to make profits to go in relief of rates. They considered they were assisting the rates by increasing the rateable value of the area by industrial development. The result was that they were supplying 250 units per head of the population in their area, which was very largely indeed in excess of the consumption per head of population in any other area in the country. That result could not have been achieved if each of the four Corporations had been acting independently, and these four Corporations had come to recognise in this joint scheme that they had got a most valuable asset. If they had the money to lay down new plant they could raise the consumption to 500 units per head. The joint scheme of these four towns was a shining example of what could be done by linking up. In Lancashire and Cheshire there were 4,350,925 people already served by various electrical undertakings. The average consumption of all those areas was something under 100 units per head, but in the next few years, if they had the capital to lay out in electrical plant, the consumption could be raised to 500 units for the whole of the area. An enormous amount of plant would have to be put down, and this plant should be laid down upon the best lines. His board gave the scheme their heartiest support, and wished it every success.

Ald. Higham (Chairman of the Accrington Corporation Electricity Committee) said that his Corporation had already expressed its approval, and heartily wished the scheme to go forward. He understood that it was not intended to put any obligations upon any authorities in which the expenditure would not be justified by the saving to be effected. Even wider powers might be conferred upon the joint board to put into effect the objects in view. He had in mind the small townships in the district served by Group D, which were begging for an electrical supply—Great Harwood, Rishton, and Padiham, which were populous and successful manufacturing areas, and were being absolutely starved for a decent supply of electricity. There ought to be some machinery whereby these small authorities could approach the joint board with a view to acquiring a cheap supply of current, to which they were undoubtedly entitled, and with which they could not possibly provide themselves.

Mr. E. Russell Taylor (Chairman of the Liverpool Corporation Electricity Committee), speaking for a group that had been left out of the working report, said that geographically they were rather different to the other groups, having a huge river dividing the area, the River Mersey. As this scheme was intended to effect a saving in coal, and it had to be done quickly, they found that, so far as Group E was concerned, it was a physical impossibility to link up with any immediate advantage. There had, however, been this advantage, that since the committee sat, districts in that area had already grouped together, namely, Bootle to Liverpool, and Southport and Birkdale. It was their intention to give every possible support to the movement so far as Group E was concerned. The war had demonstrated nothing more forcibly and plainly to them than the immense amount of waste that had taken place prior to the war, in every department of life. The time had now arrived when municipalities should pay more attention to the scientist and to the chemist, including their own engineers, to see what could be done in the saving of fuel. If coal was consumed as coal ought to be consumed, after the essentials were taken from it, leaving

quite sufficient heat in it to do its work, it would not be £82,000 that would be saved, but many hundreds of thousands of pounds. The Liverpool Electricity Committee gave the scheme its benediction.

Mr. L. Beard (Town Clerk of Blackburn), taking the point of view of the towns of a smaller size, which he thought would be those which would derive the greatest benefit from the scheme, said that the problem which was presented to the early developers of municipal electrical undertakings had been entirely changed by the passage of time. They looked upon electricity in those days as a means of lighting shops and the houses of the well-to-do. To-day it was the great source of cheap power. The result of the way in which the question was tackled at the beginning, especially in the smaller towns, was that they found themselves handicapped by their early mistakes. Each of these undertakings was too small in itself, generally speaking, to be developed into a really modern and up-to-date power-producing undertaking, and they wanted to find a solution of the difficulty, a solution in which the future of their industries was largely concerned. It was a problem not of linking-up, which was the mechanical part of it, but of co-operation. Co-operation was not a new thing to municipalities in Lancashire. They should look at the scheme not merely as an emergency war measure, the advantages of which were to be estimated by the period of the war, but as a far-reaching scheme for the future development of these undertakings over a long series of years. Some of them had been a little afraid that by coming into this joint board they might lose some of their local autonomy. He did not think that they could get the advantages which they hoped to derive from the scheme of co-operation without paying something for them. He appealed to all authorities which, like Blackburn, were on the small side, and expected to get great advantages from this scheme, to consider whether it was not worth their while to come into it at once. By so doing they would have a voice in the framing of this scheme.

Ald. F. Smith (Deputy Chairman, Liverpool Corporation Electricity Committee) held the view that it was their duty to provide as far as possible for the distribution of electricity in its best and cheapest forms. Every advance that could be made in the quick and cheap supply of electrical power was favourable to English trade.

Mr. W. H. Tyrer (Town Clerk of Wigan) said on behalf of the Wigan Corporation, that it whole-heartedly supported the principle implied in this excellent scheme of interconnection. Wigan had a scheme of interconnection with the Lancashire Electrical Power Co., and would like to know to what extent it would be possible to use what had been done there, and whether possibly it might get some contributions towards the capital. What would be the next step?

The Chairman remarked that it was a very happy omen that there was such a remarkable unanimity. They all wanted the most economical form of production. Unless they could accomplish that object in the next few years, Great Britain would be deposed from its position of commercial eminence. It was no exaggeration to say that the cheap supply of electric current afforded one of the greatest possibilities for the development of national industries in the coming years. The next step rested with themselves. It was for them to work out the details of the scheme, and then to submit them to the Board of Trade for the consideration of those who advised the political heads on the matter. He could only give the official assurance that his right hon. friend, the President, and himself were really seized with the urgency and importance of the problem, and they might rely upon it that the proposals submitted would be thoroughly investigated in a sympathetic spirit. Since he had been at the Board this was a subject that had been specially brought to his notice, and had in a very large measure been placed under his control; therefore, he was very glad to have the opportunity of listening to the many speeches that morning, and had been very much helped by being there. That conference might not only prove to have been of local advantage, but also a splendid and enduring contribution to the future development of the trade of the nation.

The proceedings ended with a hearty vote of thanks to the Chairman.

BRITISH CAPITAL AND FOREIGN TRADE.

On Monday last Mr. Edgar Crammond delivered a lecture before the Institution of Civil Engineers on the subject of "Foreign Trade and its Relation to Investment of Capital Abroad." In a brief introductory speech the President referred to the new era of efficiency and freedom from red tape that lay before us, and expressed the hope that engineers would realise their responsibilities and take broad views; questions of finance came within their scope, and investments made abroad should bring large orders to this country.

Mr. Crammond, who dealt with his subject in a masterly fashion, traced the history of British investments of capital abroad from a remote period, and gave numerous statistics showing the distribution of our investments throughout the world as a whole, and the British Empire in particular; curiously enough, the amount invested outside the Empire was approximately equal to that invested in our Dominions and Dependencies, and the latter was fairly equally divided. It was owing to our very large foreign investments that we had been able to maintain the rate of exchange and to finance our Allies, the process involving the transference of large sums from the hands of neutral nations to those of our Allies. It had been abundantly proved that shipping was our greatest industry, and our mainstay during the war, and he hoped that every effort would be made when peace returned to maintain its supremacy. British capital should be employed to increase our exports and improve our food supply—it was made clear by statistics that the countries in which our capital was invested were devoting increased attention to manufacture and neglecting agriculture, and for that reason alone, apart from the war, the manufacturing countries of the world would have been in sight of a shortage of food supplies. British capital should also be applied to develop the Empire. The new conditions created by the war had rendered necessary the adoption of a new economic policy; in the past, if we had had an Imperial policy at all, it was rather that of internationalisation of capital, war being regarded as a remote contingency. Our money market was open to the world, we were dependent on foreign food supplies, and on Germany for commodities of vital importance. In Germany, on the contrary, the tendency had been towards centralisation and the creation of a self-supporting state, discouraging the emigration of capital and labour, a policy which had brought us many economic advantages. In future the scientific direction of investment of our capital abroad was indispensable; it was of urgent importance that the British Trade Bank should be established as soon as possible, though weighty interests in the City appeared to be opposed to its formation. The growth of our shipping, the guidance of emigration, and the development of the oversea Dominions demanded attention, but we must not confine our trade to the limits of the Empire, for the world-wide character of our trade had been of immense benefit to us in the war. The Empire of which we were the trustees would be enormously increased after the war, and it was our duty to develop its economic resources, and to consolidate the Empire by means of a moderate tariff. He objected to the Channel tunnel as adverse to the interests of British shipping, and urged that British capital must not be used in the future, as in the past, to develop foreign manufacturing industries.

A discussion followed the reading of the paper. Dr. Dugald Clerk pointed out that we had four times as much capital invested abroad as Germany had, and hence had been able to maintain our rate of exchange and to obtain supplies. Self-sufficiency was shown, by the present plight of the Central Powers, to be an impossible condition. The future of the Empire, in his opinion, depended more on the engineer than on the soldier, sailor, or politician, and being carriers for the world made us also manufacturers for the world.

Mr. Harold Cox remarked on the marvellous way in which the war had shown that our economic policy had increased our military strength—the result of Imperial expansion. We must beware of too much State control, and not hamper the trade of the Empire by artificial restrictions.

Mr. W. H. Ellis referred to the question of limiting the trade of our enemies with other countries, and deprecated too ruthless a policy as against our own interests. He pointed out the defects in our methods of representation abroad, and the evil effect of competition between British merchants in the same line, and advocated joint representation under capable management. With regard to shipping, he inveighed against the absurdity of dockage terms which favoured foreign shipowners; and he thought our present banking institutions could do all that was required by industry.

The Hon. Sir John McCall (Agent-General for Tasmania) showed how his Government placed orders in this country for steel rails in spite of tempting offers from Germany, but no effort was made to see that money lent by us was spent with us, and a shameful example was set by corporations sending orders to the Continent. He thought the war had brought a glimmer of light to Free Traders, and strongly advocated a preferential tariff as a guarantee against dumping, and to secure the investment of capital in industries.

The Hon. Mr. F. W. Young (Agent-General for South Australia) said that not Free Trade, but the war itself, had saved the Empire from ruin—if Germany had waited 20 years longer, where should we have been? There was a danger that after the war our shipping would be busy returning troops to the Dominions, and emigration would be diverted to foreign countries. The income-tax laws needed amendment, as income from investments in Australasia was subject to double taxation, amounting in some cases to 13s. in the £.

Sir Robert Hadfield drew attention to the Federation of British Industries, with 350 members, which was going to make a great improvement in our trading methods by bringing about an understanding between manufacturers and preventing waste of effort through competition. We should not neglect home trade in favour of foreign trade. As for engineering opportunities, there was plenty of scope, and large amounts of money could be spent advantageously in this country.

Mr. C. Hamilton Wickes (H.M. Trade Commissioner for Canada) described his experience of many years in watching German methods of penetration in the self-governing colonies, and said that if we went on after the war, as before, the Empire would soon cease to exist. If the Germans had not been such fools as to declare war, they

would have swallowed us up in ten years. Our watchword should be *preparation*—the obtaining of information, and raw materials, the study of commercial treaties trade by trade, and the establishment of a commercial intelligence department throughout the whole world.

Mr. Crammond briefly replied, remarking that practically all the speakers agreed with the views which he had put forward, and that an Imperial economic policy was necessary.

BARE WIRE SIGNALLING IN MINES.

At a meeting of the Newcastle-upon-Tyne Section of the Association of Mining Electrical Engineers, in Newcastle, on March 5th, Dr. W. M. Thornton gave an address upon "Bare Wire Signalling." He said that the explosion at Senghenydd called general attention to the fact that under certain circumstances bells might be as dangerous as large power circuits. Mr. Carey, H.M. Inspector at Bedwas, wrote to him asking if he thought there was any risk from bells. In his (Dr. Thornton's) opinion at that time he did not think there was. Shortly afterwards he went into the subject and found that, practically speaking, any bell might be dangerous, and he patented a bell with a shunt winding for suppressing the sparking, not only at the bell, but also on the bell wire used for signalling. That was shown at the Senghenydd inquiry, where he gave evidence at the invitation of the Home Office. It had been suggested that he had patented the bell after the recent report was issued, whereas the reverse was the truth. He was asked to the Senghenydd inquiry because of his work on the subject, and afterwards to collaborate with Dr. Wheeler in an investigation of the whole question of bare wire signalling. There were two points in regard to bare wire signalling. There was the sparking at the point where the wires were brought together to send a signal. Then there was the ordinary trembler spark at the bell. This latter was not in the past generally deemed to be dangerous. By making the bell safe they made the wire safe at the same time, but they had to suppress the voltage. What was the essential of safety? Did it depend on energy, or current, or voltage? There was no doubt at all that it depended on the suppression of voltage at the spark wherever formed. When an electric circuit having self-induction was broken quickly there was a rise of voltage, which might be many times greater than the circuit voltage. On mining bells it was usually about six times the battery voltage, unless means were taken to suppress it.

Dr. Thornton then showed a number of lantern slides which made it clear that as the voltage came down the igniting power came down very quickly, until they got to 25 volts, when it took a relatively large amount of current to ignite gas, and under certain conditions they could scarcely get ignition at all. He mentioned that alternating current greatly reduced the risk of ignition. Dr. Thornton referred to the Home Office report on the subject, wherein it was laid down that the essential thing to suppress was the voltage across the spark, and four methods were given by which this might be dealt with.

The Chairman, Mr. Mark Ford, asked whether the relays used with underground bells were much safer than ordinary bells; the voltage was considerably less. Dr. Thornton admitted that the voltage was less, but said the inductance was greater, and the relays were sometimes worse than bells themselves.

Mr. Hanks raised a point as to the maximum safe voltage for signalling, and expressed the opinion that the limit should be lower. Dr. Thornton agreed that 25 volts was perhaps on the high side, but said 25 volts was accepted throughout the country. If they were using Leclanché cells it was all right, but if they used secondary cells, resistance equal to that of the Leclanché cells should be inserted in the circuit. 25 volts from a motor-generator was too much; they must have resistance inserted.

Mr. Day mentioned the 5, 8, or 12-volt transformers, and asked if they would comply with the Act. Dr. Thornton said they might get too high a voltage on the secondary circuit from a leakage on the primary.

Mr. Gunn asked whether the adoption of the shunt winding meant the consumption of more current. Mr. Hanks said his experience was that there was no increase of consumption, and Dr. Thornton said the action of the shunt really was to slow the action of the magnet. It was a wonder the device was not more used in signalling operations, quite apart from the questions of risk and suppressing the sparking, to save platinum.

Mr. Veitch said he thought the Home Office should give them a definite lead. Manufacturers, of course, made bells to sell, but if they knew what the Government wanted it would guide them in all future designs.

Mr. Hanks advocated the use of Leclanché or similar cells for underground work, especially when both positive and negative wires were run side by side, as was sometimes the case in three-wire systems. He pointed out that an accidental short circuit would probably be harmless with such cells, whereas with a battery of accumulators or a generator the effect might be disastrous.

Dr. Thornton said he quite agreed, and that was one of the reasons why he advised a certain amount of permanent series resistance in circuits where generators or cells of low resistance were used at anything approaching the maximum voltage permitted.

WAR ITEMS.

Exports to China.—A further notice respecting exports to China appears in the *London Gazette* for March 9th, giving authority to export articles to the Peking Technical College.

Exports to Switzerland.—The "London Gazette" for March 13th contains a Proclamation prohibiting the exportation from the United Kingdom to Switzerland of certain articles. Various electrical lines are included.

To be Wound Up.—The Board of Trade has ordered the following to be wound up under the Trading with the Enemy Act:—

Meirowsky & Co., Carriage Street, Old Trafford, Manchester, electrical insulation manufacturers. Controller: G. H. Warmington, 33, St. Swithin's Lane, London, E.C.

Women in Engineering.—The demand for trained women in the munition factories has not yet been satisfied. Students are urgently needed for engineering, and there is a good opportunity for educated girls of a robust type and for women who have proved their vigour in their chosen path of life. The work to be done involves tool-setting, machine operations in which great precision and keenness of judgment are essential, and various processes in the construction of aeroplane engines. The success of women in these expert processes is now beyond doubt. The training classes which have been established by the Ministry of Munitions have already turned out many hundreds of efficient workers. The preliminary training lasts from eight to nine weeks, and during that period a maintenance allowance of 25s. per week is given to approved students. All women able to undertake skilled work of the kind required should apply in writing to the Ministry of Munitions (Training Department), 6, Whitehall Gardens, London, S.W.—*Morning Post*.

German Preparations for Trade in China.—According to the *Vossische Zeitung* (Berlin), of February 9th, active preparations are being made in Germany to revive and strengthen intercourse with China. The German China Association, it is stated, has carried out a scheme whereby young Chinamen have been taken into German industrial establishments. Lectures and visits to factories and works have been arranged for the Chinese students in Germany, with a view to acquainting them with German industrial achievements. In order to provide a supply of young German traders and technical specialists with a knowledge of Chinese, the Association, in co-operation with the Oriental Seminar of Berlin University, has instituted elementary courses in colloquial Chinese, for which many students are stated to have been enrolled.—*Board of Trade Journal*.

American Central Station Industry and War Possibilities.—The American *Electrical Review and Western Electrician* for February 17th devotes its leading article to the threatening war situation and the preparedness of the central station industry to fulfil its part in whatever may occur. We make the following extracts:—

"To-day the country stands at the brink of an unknown situation, one that has passed beyond the country's ability to control. The future is pregnant with uncertainties; at any moment latent possibilities may arise to become stern realities. While uncertainty lurks broadcast over the land everywhere is to be found feverish excitement and frenzied effort in preparation for whatever the future may have in store. It is a time when much has to be done, when the time in which to do it may be short. Forced outputs are the order of the day. . . .

"The central-station industry stands prepared, already mobilised, ready to serve the individual, the community, and the nation, whether for peace or war. Solidly and surely founded it stands, the central-station industry, not the creation of a moment's hasty frenzied action, but the evolution of wise, far-sighted policies, careful and painstaking development, and judicious fostering. Long since have intensive co-operation and unified effort been the keynotes for the cheap and reliable generation, transmission, and utilisation of electrical energy. Unification of effort has come out of duplication, co-operation has grown out of competition, and efficient monopoly has absorbed the agglomerations of concerns of all sorts and sizes, giving us what we have to-day—cheap, reliable power, flexible, ever ready in bulk or the smallest quantity. Out of war-stricken Europe word has come from time to time of the value of central-station service, of how it has made possible the conservation of materials of the warring nations, of how it has enabled forced production to be obtained where existed a scarcity of labour, and time was short. This country is fortunate in the extreme in not knowing the stress of necessity that arises from the insatiate demands of war in our midst. We are fortunate indeed in being privileged to be able to watch and learn afar lessons

being taught by the dire suffering and agony of others. Peace or war, the central-station industry is mobilised in readiness to serve the individual, the community, and the nation. Take advantage of it now, for there is no time like the present, and this applies with more than usual truth in the present instance. Extensions to existing plants are handicapped by the scarcity of machinery and inability to obtain immediate or quick deliveries. It will in the majority of cases be found quicker, cheaper, and eventually the more pleasing, to resort to central-station service. The nation-wide coal shortage is driving many to central-station service. The larger the consumer the less likely is he to suffer from coal shortage, because he is better able to guard against embargoes, congested railroads, and those other factors causing erratic deliveries, sporadic famines, and fluctuating prices. The user of central-station service is practically immune from the condition of the coal market, whereas the owner of an isolated plant is constantly faced with the problems of reduced working hours, restricted outputs, fluctuating costs, and uncertain deliveries.

"Vast numbers of industrial concerns are flocking to central-station service, entirely or in part. Many are finding the present time particularly opportune to abolish their isolated plant and substitute central-station energy entirely because the price of scrap metal is high, as high as it may reasonably be expected to attain, and selling their isolated plant now realises handsome profit in addition to the economy and convenience that accrue in the way of greater available space, lower energy charges, &c., from central-station service."

Exemption Applications.—Before the East Central of Yorkshire Appeal Court, the Military appealed against exemption held by N. Tate (23), engaged as a mechanical draughtsman with the Yorkshire Power Co. The appeal was allowed, and the calling-up deferred until the middle of April.

At Llandudno, the Llandudno and Colwyn Bay Electric Railway Co. appealed for an electric car driver, who is in a low category. The general manager, Mr. A. G. Balfour, said that they had just voluntarily released two Class A men. It was necessary to have a staff of competent drivers and mechanics. The Military Representative suggested that a reduced service of cars should be run in order to release more men. The man appealed for was conditionally exempted.

At Bexhill-on-Sea, Messrs. J. L. French & Co. appealed for further exemption for Mr. H. E. Mullinger, manager of their electrical department, in order to complete several contracts. Appeal disallowed; calling-up fixed for April 7th.

Four tramway drivers, aged respectively 30, 31, 34, and 37, were appealed for at Birkenhead by the Corporation. It was stated that the men were selected out of 20 in the service to be substituted. Exemption was refused, and the cases were referred for substitution.

Maidstone Tribunal has withdrawn, on the appeal of the Military, conditional exemption held by J. Bowden (39), wireman, formerly engaged in the Corporation electric light department.

Before the South Yorkshire Appeal Court, the Mexborough and Swinton Tramway Co. appealed for a switchboard attendant. The local Tribunal had given exemption until April 16th, but recommended that an older man should be trained for the work. The Military Representative stated that the man was 21, single, passed for general service, and had had a year's exemption. The appeal was dismissed.

Before the Herts. Appeal Court, on March 3rd, the North Metropolitan Electrical Power Supply Co., Ltd., appealed for Mr. A. Brown (25), senior clerk and cashier at St. Albans, placed in Class B3. On behalf of the company it was stated that it was intended that the whole of the staff should enrol for national service, and Mr. Brown promised to enrol. Subject to that, six months' exemption was granted.

At Peterborough, appeals were entered by the Electric Traction Co. for J. G. Manning (28, Class A), tramway electrician; E. A. Sowter (30, B2), electric car fitter and turner; and F. G. Jessop (29, B2), mechanic and driver. The two former were granted until April 9th, and the last-named was conditionally exempted.

At Reigate, the Tribunal has granted temporary exemption until May 6th to J. G. Toonjan (28), shift engineer at the Corporation electricity works.

At Deal, an appeal was made for C. H. J. Graves, electrician at the South-Eastern Hotel. It transpired that an elderly substitute had been obtained, and a short period was sought to make him better acquainted with the work. The Tribunal granted a fortnight beyond March 19th, when the previous exemption expires.

After a review, the Folkestone Tribunal has confirmed conditional exemption held by Mr. Marchant (41), on the staff of the Electric Light Co.

At Aldershot, on March 6th, the Traction Co. appealed for A. J. Chitty (30, in Class A), foreman engineer fitter, claimed to be in a certified occupation. The Tribunal decided that the man was not in a certified occupation, and they allowed a final month for the company to make arrangements.

Diesel Engine Making in Sweden.—A new company has been formed in Stockholm, with a capital of over £1,100,000, for the manufacture of Diesel motors.—*Times.*

LEGAL.

Backner *v.* Mile End Palladium, Ltd.

In the King's Bench Division, on March 7th, before Mr. Justice Shearman and a common jury, an action was heard in which Arthur and Constance Backner, kinematograph artistes, sued the Mile End Palladium, Ltd., to recover damages in respect of personal injuries caused to the female plaintiff by contact with an electric generator used for the supply of light at the Palladium, and also for loss caused to both the plaintiffs through failure to keep professional engagements on account of the lady's injuries. The case for the plaintiffs was that in January, 1916, they were performing at the time in what are known as "synchronised pictures," and the lady was shown a certain room for the purpose of changing her theatrical dress. In this room was the dynamo, and the female plaintiff said that her dress was caught in it, and she was drawn to the dynamo, and her knee and leg injured. As the result of the injury, the female plaintiff had to have medical attention, and both the plaintiffs suffered loss through inability to carry out booked engagements at other kinema houses. The defendants denied that they were guilty of any negligence or breach of duty, and they denied liability to pay compensation.

The jury found for the plaintiffs, and awarded £50, and judgment was entered accordingly, with costs.

Leaving Certificate.

At Bolton Munitions Tribunal, last week, an electrician employed by the Corporation applied for a leaving certificate, on the ground that his skill and qualifications were not employed to the best national interest in his present employment. He wished to go to a local Council's electrical distribution plant to take charge. His present wages were only two guineas per week, while at the other place he could get £2 10s.

It was stated that applicant was engaged on work of great national importance, inasmuch as he was keeping the plant going for the production of material for which the Government was pressing. The Corporation had spent over £7,000 to install additional plant, and if this man went away they had no man to replace him.

The leaving certificate was refused.

Claim for Theatre Electrical Installation.

Mr. Pollock, High Courts Official Referee, on March 7th, gave his reserved judgment in the action in which Messrs. F. W. Vaughan and Co., Ltd., electrical engineers, Islington, claimed the balance of the contract price (£1,700) and extras for putting up an electrical installation at the Golder's Green Theatre of Varieties for the Golder's Green Amusement and Development Co., Ltd., who were the defendants. The case has already been reported in our pages.

The Official Referee, in giving judgment, said that of the contract price there was an unpaid balance of £609, in addition to which the plaintiffs claimed £382 for goods sold and delivered. The defendants admitted the contract, but denied that it had been properly executed, and claimed that they had had to do various things which were left undone. They also denied that they had received proper notice of the assignment of the old company to the new (plaintiffs), and they counterclaimed for a large amount. He (the Referee) was satisfied, upon the case put before him on behalf of the defendant company, that there was no proper notice of assignment of the old company to the new company which would make the defendants liable in an action brought by the assignees. The question then arose as to what were the respective rights of the parties in respect of the contract. There was no doubt that during the first part of the correspondence between the parties, the plaintiffs thought they were in a position to sue upon the contract; but, in his opinion, they were not in that position, and all they could sue upon was the assignment. Supposing there were any balance beyond the set-off, the defendants could not recover it from the plaintiff company. The plaintiffs had launched their case entirely upon the contract—and their right to recover on the amount of the contract—and they now sought to base their claim for extras on a *quantum meruit*. In his opinion, they could not do that. When parties had done work on a contract, they could not depart from it, and must necessarily sue upon the contract. In his opinion, Mr. Crew did not, and could not, make any variation in regard to the area of the cables, but Mr. Mitchell had said that they might have an extra in regard to it. It was pointed out that the cables required by the contract would have cost a great deal more than was allowed by the contract. For extras, an order in writing was required, but no such orders were given; and, moreover, he was not satisfied that the contract was carried out in accordance with the specification. In regard to other items, he had looked at the case in this way. Mr. Crew, who had acted on behalf of the defendant company, had said that certain things were ordered by the managers, and it was hardly fair under the circumstances for the defendants to say that they would not pay. In the result, he found that £744 was due to the plaintiffs, from which had to be deducted £130 to complete, making the amount £614. In addition, they were entitled to £50 balance on the contract, and other small amounts, making the sum due to the plaintiffs on the claim £684. As to the set-off he thought, having regard to the evidence, the sum of £700 for the cables was quite moderate, and as to the other matters, he awarded £300.

Mr. Pollock, K.C., said that the result of the judgment, after arranging the figures, was that it wiped out the claim of £684,

and left a balance of £186 due to the defendants. He, therefore, asked for judgment for the defendants on the claim and the set-off.

The Referee said there would be judgment for the defendants on balance of claim and set-off, with costs, and the counterclaim would be dismissed, without costs.

A stay of execution was refused.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

This case came before the Court of Appeal, composed of the Master of the Rolls and Lords Justices Warrington and Scrutton, on Tuesday last week, upon the appeal of the plaintiffs from a judgment of Mr. Justice Astbury, in the Chancery Division, in favour of the defendants.

Mr. A. J. Walter, K.C., Mr. Colefax, K.C., and Mr. J. H. Gray appeared in support of the appeal, and Mr. T. Terrell, K.C., Mr. Kerby, K.C., and Mr. Courtney Terrell for the respondents.

Mr. Walter said the appeal was from a judgment of Mr. Justice Astbury in December last. The action was originally for the infringement of two patents by the defendants, but the appeal was only with regard to the patent of 1906. Mr. Justice Astbury had dismissed the action on the ground that the plaintiffs' patent was bad for want of subject-matter. After explaining the circumstances, he dealt exhaustively with the evidence given in the Court below and all alleged anticipations on which the defendants relied, and contended that nobody before the present patentee had ever solved the problem which he had successfully solved, and which had proved of the greatest importance and utility. The plaintiffs' patent was worth hundreds of thousands of pounds, and had undoubtedly contributed valuable information as to the metallurgy of tungsten.

Mr. Colefax having followed on the same side,

Mr. Terrell, in support of the judgment of Mr. Justice Astbury, said that the view that the respondents wished to put before the Court was that the plaintiffs' patent never did anything at all, and that the present action was brought for the purpose of trying to see whether the persons owning the patent could not reap the reward due to other inventors. His learned friends on the other side had been floundering for a long time in this case, and at last were crystallised down to one or two things—one of which was that nobody had ever made tungsten in the form of a rod before. But the patentee claimed a vast amount more than that. If it was electrically conductive, it did not matter whether it was a rod or a block. The patentee had put in two claims, one of which was "electrically heated," and the other was "general." He did not limit himself to a rod, but a piece of solid metal which was capable of being heated, and, when heated, hammered.

Lord Justice Warrington: He does not in his description necessarily contemplate heating by electricity?

Mr. Terrell: No.

Mr. Walter: We never suggested it.

Lord Justice Warrington: What is the meaning of the claim?

Mr. Walter: A special form of wire which is being treated electrically.

Mr. Terrell: It is plain it is not limited to the metal tungsten in the form of a rod. It is much more general than that. I say it is a patent for making tungsten in any form, and, when hot, hammering it into any shape. Before the date of the patent it was known that you could make incandescent filaments of tungsten. The minute you are told that these highly refractory metals are capable of being consolidated by being made intensely hot in the battered form, you have got the whole thing. Wilson, Moissan and Welsbach told you that.

Lord Justice Warrington: And Just and Hanaman told you that.

Mr. Terrell: Yes. Dealing with Moissan, Mr. Terrell said it was beyond doubt that Moissan had in his possession pure coherent malleable tungsten. The secret of the malleability of tungsten was that you elongated the crystals. That was all it came to. In conclusion, he submitted, on the face of the plaintiffs' specification, there was no subject matter, and that on the face of the specification it was blown out of Court. He also contended that the alleged invention was completely anticipated by Moissan and Siemens. For these reasons he contended that the appeal failed.

Mr. Hall followed on the same side.

On Monday, Mr. Walter replied on behalf of the appellants, contending that the plaintiffs' patentee was the first to tell the world how to get an agglomerated body of tungsten. He submitted that the plaintiffs' patentee was on absolutely sound ground, and that the attack made on the specification was not one warranted by the law relating to patents in this country. He asked the Court to allow the appeal, and to grant the appellants the relief they claimed.

Judgment was reserved.

Tramcar Accident Claim.

At Glamorgan Assizes, David Williams, contractor, of Caerphilly, was awarded £700 damages against the Rhondda Tramways Co. for injuries received as a result of the sudden stoppage of a tramcar.—*Times.*

British Power, Traction, &c., Co., Ltd., *v.* Hodgson.

Mr. Justice Peterson, in the Chancery Division on Tuesday, disposed of a summons by which the plaintiffs in this action claimed taxation against the defendant of the costs since the judgment, given so long ago as 1905.

By consent judgment was given against the defendant in respect of certain alleged breaches of trust, and £7,652 11s. 11d. was found due from him under that judgment. Between the issue of the writ and judgment the defendant became a bankrupt, but the bankruptcy having been annulled, the Court recently held that as the judgment was based upon legal fraud, the defendant was not absolved from liability under it by the bankruptcy.

On behalf of the defendant, it was now argued that though the bankruptcy did not absolve him from liability as regards the judgment it did with respect to subsequent costs.

His Lordship, however, did not accede to that view, and directed taxation as asked for by the plaintiffs.

BUSINESS NOTES.

Federation of British Industries.—A report of the first general meeting of this Federation, held on March 2nd, was published in a number of daily papers on Monday last. Mr. F. Dudley Docker, C.B., who presided, said that the membership had now reached a total of 269 firms and individuals and 50 associations, with 18 applicants awaiting election, making a total of 337. He thought in the near future it would be increased to at least 1,000. They were engaged upon a great experiment, upon which the whole future prosperity of the country might depend, but they could not carry it on with their hands tied. They must be free to develop perhaps into a Federation of Associations, perhaps into some other type of organisation. They had chosen certain principles, which they intended to observe, and their object was to secure united action by the manufacturers of the country through a national federation for the development of the industry of the country. If they tried to lay down a fixed programme of policy before they had included in their membership all the manufacturing interests of the country, they could not become a national federation; they would only be a Federation of the persons who happened to agree with that programme. If they adopted an immutable form of constitution they would lose the chance of learning from their mistakes, and in an experiment so novel as the attempt to secure united action by British manufacturers they were bound to make many mistakes. They must first get together and learn to consult each other before they took action, and to modify their individual wishes and views, so as to conform to the common good. When they had done that they could take vigorous and united action, and from that consultation and action they could develop a constitution and a policy based upon a practical experience of their requirements. Mr. Docker referred to arrangements made with other bodies formed with objects not dissimilar to those of the Federation, for application to the Federation, notably the Employers' Parliamentary Association, by which the various district branches of that Association would become branches of the Federation. The British Manufacturers' Association (a body chiefly composed of smaller manufacturers) had joined as an Association. The British Empire Producers' Association was also working, to a certain extent, in conjunction with the Federation, there being a Joint Committee of the two bodies, which met at stated periods to discuss matters of mutual interest. Satisfactory arrangements had been made also with the Engineering Employers' Federation to work in co-operation. The question of their relations with Labour called for all the patience, tact, and consideration that they could command. If the Federation did nothing more than it had done already to bring Capital and Labour together, it would be an achievement to be proud of. Meetings of Employers and Labour held at Birmingham, Cardiff, Manchester, &c., had had a good effect, and the atmosphere of friendliness and co-operation which they had engendered would make subsequent negotiations with Labour more easy and more productive. It would be necessary to speak plainly to Labour in future, not to be afraid to ask for what they wanted, and not to be afraid to give what they ought to give for fear of something more being demanded. The welfare of the Empire was essentially dependent upon the existence of a satisfactory understanding between Employers and Employed, and he hoped that the Federation would play an important part in promoting such an understanding. Other matters briefly touched upon by Mr. Docker were the questions of a Trade Bank and organised education.

Book Notices.—*Guide to the Registration of Business Names Act.* By Kenneth Brown. London: Sir Isaac Pitman and Sons, Ltd. 1s. net.—The author had occasion to prepare a synopsis of the provisions of the Act named, for the members of the Wholesale Grocers' and Provision Merchants' Alliance, Ltd., and being deluged with inquiries, he has elaborated that synopsis in this book. He deals with many difficulties which the queries raised show business men to feel as to the Act. We need say nothing more to suggest the potential usefulness of this publication.

"Science Abstracts." A and B. Vol. XX. Part II. February 26th, 1917. London: E. & F. N. Spon, Ltd. Price 1s. 6d. each net.

"Atoms." By J. Perrin. Translated by D. Le Hammick. London: Constable & Co. Price 6s. net.

"Manual of Reinforced Concrete." By C. F. Marsh and W. Dunn. London: Constable & Co. Price 10s. 6d. net.

Fined.—A local firm of electrical engineers complained, at Oldham Munition Court, that three workmen had absented themselves from work. They were each earning over £3 a week. A fine of 19s. was imposed in each case.

New Companies in France.—A new company has lately been formed in Lyons (13, Rue Grolèe), with a capital of £20,000, and the title La Société Electro-Métallurgie d'Auvergne, to engage in the electrical production of ferro-silicon and other alloys, special steels, and all classes of electrometallurgical and electrochemical products.

A new company has lately been formed in Paris (9, Place des Ternes), with a capital of £40,000, and the title La Compagnie des Machines et Magnétos Zenith, to engage in the manufacture of ignition magnetos for motor vehicles.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, E.C.—Catalogue of 28 pages, detailing and pricing "Paramho" wires and cables, and accessories for the use of wiremen. These wires, cables, and flexible cords are made in accordance with the C.M.A. specifications, and are supplied in several grades to meet various conditions of service. Large stocks of practically all the cables and accessories listed are held at Mazda House.

Messrs. T. W. Broadbent, Ltd., Victoria Electrical Works, East Parade, Huddersfield.—Eight-page leaflet (No. 5) containing description and tabulated particulars and prices of their N-type squirrel-cage motors. Copies may be obtained on application.

Messrs. Vincent Roberts & Co., Leeds.—Eight-page illustrated pamphlet, describing their new patent electrolyser for use on board ship, in hospitals, &c., its construction, mode of working, and utility.

Trade with Italy.—The British Chamber of Commerce for Italy, at Genoa, includes the following in its latest lists of openings for British articles in Italian markets :—

No. 1,247.—Works at Turin would buy: Electric lamps and electric motors, &c T.S.T.A.T.

No. 1,252.—Party at Foggio Imilia would buy: Electric lamps, wire, insulators, apparatus, and other electric sundries. R.S.T.

No. 1,262.—Merchant at Turin would handle: Electrical articles, electric lamps and accessories, illumination plants, &c., engineering articles for mechanical engineering, ammunition works, tools. T.D.G. 5.

No. 1,263.—Party at Rome would represent, or buy for own account: Manufacturers of machinery and tools. R.M.P.

No. 1,266.—Party at Rome would represent manufacturers of: Industrial machinery, electric motors, &c. R.V.D.A.O.

Liquidations.—Electric Railway and Tramway Carriage Works, Ltd., British Electric Car Co., Ltd., and George F. Milnes & Co., Ltd.—Meetings are called at Manchester for April 10th, to hear an account of the winding up from the liquidator.

Quarzlampen Gesellschaft, M.B.H.—The Controller, Mr. R. W. Brown, 12, Old Square, Lincoln's Inn, W.C., has applied for his release.

Excel Water Circulator Co., Ltd.—This company is winding up voluntarily, with Mr. F. E. Smith, 3, St. Helen's Place, E.C., as liquidator. Meeting of creditors, March 27th.

"Dac" Accumulator Syndicate, Ltd.—Creditors should send particulars of their debts, &c., to the liquidator (Mr. H. C. Bound, 61 and 62, Lincoln's Inn Fields, W.C.), by April 9th. Meeting to hear account of liquidation, April 20th.

LIGHTING AND POWER NOTES.

Accrington.—At the meeting of the T.C., Ald. Higham, referring to the revised and increased scale of charges for electricity, said that all consumers were being asked to bear some of the added cost of production. The additional charges were sufficient to meet the added cost, and the Committee hoped that in the year commencing April 1st the works would be self-supporting, with possibly a little surplus ; one of their largest consumers had waived their electricity contract, which did not expire until 1918, and had entered into a new agreement at a higher price.

Aldershot.—Addressing the meeting of the Aldershot Gas, Water and District Lighting Co., Mr. W. T. Robertson, the chairman, said that the electricity department had completed its second year, and the results had been marvellous. It was extraordinary to start a new business, and at the end of the second year to be able to place on record that it was paying its expenses. He did not know that there were very many electric light companies in the country which could start their business *de novo*, and in two years record that it was paying its expenses.

Australia.—The working of the Perth (W.A.) City Council's electrical undertaking for the year ended October 31st last, resulted in an output sold of 5,777,182 units, an increase of 8 per cent. over the previous year. The number of connections increased 11·33 per cent. to 8,015. The general manager reported that the greater portion of the apparatus for changing the consumers' installations had been received, and the rewiring of consumers' premises for the A.C. system had been completed. Great progress had been made in rearranging the distribution system for the new supply, some 10 miles of fourth wires have been erected, and small extensions of pole lines have been made. The total length of pole lines is 114·1 miles. The wires have been attached to extensions of the steel tramway poles in the principal city streets, and about 300 wooden and steel poles have been taken down, thus greatly improving the appearance of the streets. The gross profit on the electric supply was £37,937, as compared with £37,725 in 1915. The expenditure to date in connection with the new electric system totals £112,878, including all new buildings, plant, consumers' apparatus, and labour, and it is estimated that a further sum of £49,000 will be required to complete the conversion.—*Commonwealth Engineer.*

The Mayor of Subiaco (W.A.) in a report states that, owing to the continually increasing demands on the capacity of the electric lighting plant, the question of extensions will have to be taken into consideration shortly.

The Echuca B.C. (Vic.) has rejected the proposal of the Milo Co. to install electric lighting and pumping. Inquiries are to be instituted as to whether a loan could be obtained for a municipal electrical scheme.

The Victoria Park (W.A.) Council proposes borrowing £3,750 to carry out electric light installations, in addition to other works.

The Gladstone T.C. (Queensland) has decided to accept an offer to light the streets with electricity, at a total cost of £210, for 14 lamps of 350 C.P. The offer included the erection, supply, and maintenance of the lights for 22 nights each calendar month, and the increased cost on the present system of lighting will amount to £110 per annum. The offer is for a 10 years' agreement.—*Tenders.*

Belfast.—The deputation recently appointed to wait upon Sir John Snell on the subject of extension of the electricity undertaking, has submitted a report to the Tramways and Electricity Committee ; consideration is held over pending the receipt of Sir John Snell's report.

The latter is understood to advise certain small expenditure on the existing plant, which it is considered will be able to meet the peak loads of another winter with plant in reserve to the extent of 3,400 KW. Sir John advises the Committee to complete all its plans for the new station at Hamilton Road, so as to be able to carry out the work at a favourable opportunity. According to the statement of the Committee, the margin of plant at the electricity station was so small that it was necessary to refuse new consumers, and about 60 applications have been held up for that reason, which are now to be proceeded with.

Birkenhead.—Price Increase.—The Electricity Committee recommends that from April 1st the charge for electricity for lighting be increased by 5 per cent., and in the case of prepayment meters from 5d. to 5½d. within the borough, and from 6d. to 6½d. per unit outside the borough.

Bradford.—The T.C. has given authority to the electrical engineer to proceed with the new cooling tower foundations, and also to prepare a scheme for additional cooling towers. Tenders to be invited for the same.

The Electricity Committee has authorised the purchase of two electric (5-ton) chassis and one petrol (25-cwt.) tipping wagon for the leading of coal and ash to and from the Valley Road works. This has been necessitated by the shortage of carters and vehicles.

Buckfastleigh.—The U.D.C. has assented to the Electricity Co. using overhead mains for the supply of current to a local hospital at Bigadon for the period of the war and the year after, at the company's risk.

Chorley.—Workhouse Lighting.—The Guardians have had under consideration a report by Mr. A. W. Paul, consulting engineer, as to the lighting, &c., of the workhouse, recommending the installation of a steam-driven electric lighting plant, the exhaust steam from this plant to be used in the calorifiers for heating and hot water supply, and have decided that Mr. Paul draw up a scheme for the work.

Continental.—Russia.—A note from Abo, Finland, says that the charge for energy has been increased there by 10 pennis per KW.-hour for motor power ; Moscow advices announce an advance in the price by the Electricity Transmission Co., and similar announcements come from Veaborg, Kishinieff, Elizabetgrad, Taganrog, Nizhni-Novgorod, Kazan, &c., where the price of current has either been advanced, or the step is under consideration.

The Reveal T.C., owing to the serious condition of the municipal electrical station, has asked subscribers to use as little current as possible, so that the lighting of the town and the water supply may not be interfered with.

The demand on the Kieff electrical station has grown to such an extent, that trouble will result unless many consumers reduce their demand. It is proposed to increase the price to users.

A note from Lutsk says that when the Austrians left that town they destroyed the electric lighting station, so that for a long period the inhabitants passed their nights in darkness. The necessary repairs have now been effected, and the town is illuminated in the evening.

The assistant town governor of Odessa, Mr. L. N. Metchnikoff, has submitted a report to the Council suggesting that, in view of the difficulty in obtaining coal, water power should be used. The first year's cost is estimated at 54,000 roubles. The present annual cost is 53,000 roubles. In consequence of the bad quality of the coal used at the electrical station, its output is affected, particularly between the hours of 6 and 7 p.m., when it has to carry its full load, and certain less important districts have to be cut out.

Besides being engaged on the proposal to raise the price of electric current, the Elizabetgrad T.C. is suffering from a lack of meters which were long ago ordered by the town, but have not yet been delivered. It has been decided to make a fixed price for 25-C.P. lamps for a year, which would obviate the need for meters.

The Smolensk T.C. has bought up the local electrical company's concern for 500,000 roubles.

On October 4th, O.S., 1916, the Kieff T.C. decided to increase the tax on current from 5 to 20 per cent. to meet various increased

expenses falling on the town; it is now protested that this tax is a heavy burden out of all proportion to any advantage obtained from it.

On the proposition of the General Governor, the electrical station belonging to O. Mazing, in Omsk, has been sequestrated, and passes under the control of the Board of Land and Government Properties, according to the decree of the Council of Ministers, duly confirmed.

Dublin.—The Citizens' Association Executive has entered a protest against the action of the Corporation Housing Committee in having, without an estimate from an outside firm, placed contracts for electric lighting valued at £230, with the Corporation electricity department.

Eccles.—The Council has obtained terms for a bulk supply of energy from the Lancs. Electric Power Co.

Elland.—In order to give the Council a concrete case to work upon, Mr. Holroyd, a member of the Council, offered, at a recent meeting of the Electricity Committee, to take current on a standing charge of 15 per cent. of the rateable value of his house, plus ½d. per unit for current used, and to sign an agreement that the Council should not lose anything through the experiment. The offer was accepted.

Gloucester.—The Electricity Department reported that the energy sold during the month of January was 189,000 units, being an increase of nearly 23,000 units, and the traction output 44,300 units, showing an increase of over 4,000 units, as compared with the corresponding month of last year.

Ilford.—Proposed Loan.—Correspondence is proceeding between the Council and the L.G.B. with regard to an application by the former for sanction to borrow £10,000 to utilise steam at the refuse destructor works, and augment the supply of electricity.

Kirkcaldy.—Proposed Plant Extensions.—The Electricity Committee having rejected the recommendation of Sir J. Snell that the present generating station should be sold to the Fife Electric Power Co., and that electricity should be purchased from the company, the manager has submitted two schemes for the consideration of the Committee:—(1) Remodelling the existing generating station, at an estimated cost of £19,000; (2) to erect a new station near the sea in the near future, and to make temporary extensions at the present station to tide over the next 3 or 4 years, at an estimated cost of £25,000. Without committing itself to any scheme, the Committee decided to recommend the T.C. to apply to the Secretary for Scotland and the Treasury for permission to borrow £27,000.

London.—The Kensington Council has agreed to the conversion of 52 street lamps from series to parallel working, at an estimated cost of £72; the Council has also agreed to extend the period during which the Notting Hill Co. may charge 6d. per unit to September 30th next.

Fulham.—The Electricity Committee has recommended the B.C. to increase the charges for electricity by 5 per cent.

Motherwell.—Proposed Plant Extensions.—A report prepared by a Sub-Committee of the T.C. on the necessity of increasing the generating plant, with a view to meeting prospective demands, states that the day load has increased by 50 per cent. during the last two years, and that shortly 1,000 additional H.P. for motors will be required. Of the three suggested methods of increasing the available power, (1) purchasing in bulk from the Clyde Valley Co., was impossible, because the company's plant was fully loaded; (2) the possibility of building a new works, was rather doubtful; and (3) the remaining scheme, of extending the present works, involves the removal of certain plant and substituting a 2,000-KW. turbo-alternator, which would increase the total plant capacity by about 1,600 KW. It is proposed to adopt the H.T. alternating system of generation and supply to large consumers, and the estimated saving by introducing such plant is about £1,500 per annum. To carry out this work, it is proposed to ask for sanction to a loan of £30,000.

New Zealand.—It has been estimated that owing to the increased use of electricity in Christchurch, from the Lake Coleridge hydro-electric plant, the amount of coal received in the city last year showed a decrease of 27,000 tons as compared with the amount of coal normally used.—*Commonwealth Engineer.*

Pontypridd.—Year's Working.—The accounts of the Council's electricity undertaking for the year ended March, 1916, show a total revenue of £12,468, as against £11,557 in the previous year; and after meeting all charges, a profit of £374 is shown, as against an even balance in the previous year. Contributions to sinking fund in respect of working-capital loan, and capital expenditure out of revenue in respect of plant on hire amounted to £1,827, towards which rate aid contributed £1,130; and after allowing for various balances brought in, a deficit of £171 was carried forward. Some 1,630,150 units were sold, the maximum load amounting to 922 KW.

Sheffield.—According to the *Sheffield Independent*, the Lord Mayor, the Deputy Lord Mayor, town clerk, and the manager of the electricity department had an interview in the House of Commons, last week, with the local members of Parliament, concerning the proposed new power station at Sheffield. It was agreed to prepare an amended scheme to submit to the authorities, which can be utilised for approved industrial purposes at an early date.

Prov. Order.—The B. of T. is to hold an inquiry into the application for an electric lighting prov. order for Wortley; Sheffield Corporation is objecting to the Order, and has engaged counsel.

Shipston-on-Stour.—The B. of G. has received from the Receiver of the old Electric Light Co. an account for £20, together with a letter asserting that the Board had not fulfilled its part of the contract, which contained a penalty clause of 2s. per hour during which there was no light. The time during which there was no light was 162 hours. The Board has decided to ask the Receiver where it had failed to carry out the agreement.

Sleaford.—Price Increase.—The U.D.C. has decided to increase the charges for current by ½d. per unit for lighting and heating, and by ¼d. per unit for power.

South Africa.—According to the Cape of Good Hope *Official Gazette*, the Electric Light Regulations framed by the Paarl (C.P.) Municipal Council, under the provisions of Ordinance No. 6, of 1911, have been approved by the Administrator.—*Board of Trade Journal.*

Johannesburg Cable Trouble.—The Municipal Council is proposing to renew certain of the heavy direct-current feeders, each consisting of two cables of 1 sq. in. cross section, which supply the town area. Ten of the 13 feeders were laid in 1905-6 to the specification of Messrs. Mordey & Dawbarn, and were of the paper and bitumen-insulated steel-armoured type; these after a few years led to serious faults, owing to the decentralisation of the conductor, and in 1912 they were relaid solid in troughs, with the steel armour stripped off. About two years ago trouble restarted, the deterioration of insulation having been only delayed, and the question of completely renewing the 10 D.C. feeders at a cost of £33,550 has been under consideration, but not yet carried out, owing to lack of funds. It has been decided as a preliminary step to renew those feeders, &c., which control the central business section of the town; in this way a further expenditure (after allowing for the value of copper recovered) of about £11,000 will serve to relieve the present position. The cable will be of an approved type suitable for any future scheme for supplying the inner area.

Queenstown (Cape Prov.).—In his annual report to the Council, the electrical engineer (Mr. W. Bellad-Ellis) mentioned that during the year ending December 30th, 1915, a total of 132,833 units were generated, and for the same period of 1916 the output was 150,652 units, an increase of 17,814 units. Mr. Bellad-Ellis recommended to the Council a scheme for developing a cooking and heating load, charging a fixed sum per month equal to the average cost of lighting, plus 2d. per unit for the first 50 excess units and 1½d. for every additional excess unit.

St. Helens.—Proposed Loan.—The Corporation Electricity Committee has resolved to apply to the L.G.B. for sanction to a loan of £5,500 for electricity purposes.

Stretford.—The Council has re-appointed Mr. Thomas L. Miller as consulting engineer for a year.

At the last meeting of the Electricity Committee, a discussion took place on the augmentation of the electricity supply and the provision of additional plant. The recommendations of the Sub-Committee will in due course be submitted for full consideration.

The Council has agreed to contribute 16 guineas towards the expenses of the Hackney electricity rate case.

Stockport.—Plant Extensions.—At the last meeting of the T.C., the electrical engineer (Mr. R. Lomax) presented an exhaustive report on the necessity of installing additional plant. The units generated for all purposes in the year 1910-11 were a little over 5½ millions, as compared with 22 millions estimated for 1916-17. They were now generating well over 500,000 units a week, therefore upon present demands the output for 1917-18 would exceed 26 million units. The scheme was approved.

The T.C. has decided to ask for official permission to install the additional plant required at the works, although, in view of the linking-up scheme, it appears to be doubted whether such permission will be granted.

The Electricity Committee has re-affirmed its previous decision not to contribute towards the cost of the Hackney electricity rate case, on the ground that both the electricity and gas undertakings are under the control of the Stockport municipal authority.

Tasmania.—The Government has placed the orders for extensions of the Great Lake hydro-electric scheme, the present capacity of which is 10,000 H.P. The hydraulic equipment consisting of steel pipes with valves, and the 8,000-H.P. Pelton wheel will be supplied by Messrs. Boving & Co., Ltd. The new pipe line will have a capacity of 16,000 H.P., but it is only intended to install an 8,000-H.P. tubine set to supply the present demand. The present generating machinery consists of two 4,050-K.V.A. British Westinghouse alternators, and a third unit of 7,000 K.V.A. is on order from the Australian G.E. Co.: the additional transformers in the power house and sub-stations will be supplied by the British Westinghouse Co., whilst the equipment for the 4,000-K.V.A. outdoor sub-station at North-West Bay will be supplied by the Australian General Electric Co.; four 1,333-K.V.A. transformers (including one spare) have been ordered. The sub-station will supply the power required for the manufacture of carbide and the electrolytic treatment of zinc ores by the Gillies process.—*Commonwealth Engineer.*

Todmorden.—Gas *v.* Electricity.—At the T.C., last week, on a proposal of the Electricity Committee to spend £10,000 on new plant, the Finance Committee suggested that the matter be deferred six months. Mr. Brook (chairman of the Electricity Committee) said the proposal was absolutely necessary to bring the plant up to date and supply power consumers, or the whole undertaking might as well be scrapped. The Chairman of

the Gas Committee denounced the proposal, and said it would only increase the annual loss of £2,000; he contended that the proposal meant selling at 1d. per unit what would cost 2d. per unit to produce, but this statement was ridiculed in the Council, and the proposal to defer the matter was defeated.

Walsall.—The Electric Supply Committee reports that so long as there is only one generating set at the new generating station, it will be necessary to keep Wolverhampton Street station fully staffed and ready to take the load at any moment. The electricity mains are to be extended to the works of Gas Developments, Ltd.

In order to raise £45,924 for capital expenditure in connection with the new generating station at Birchills, the Finance Committee recommended that instead of exercising statutory borrowing powers by the creation of additional Corporation stock, the amount should be taken from the Corporation Loans Fund. The Council, at its meeting on Monday, decided to agree to this course.

York.—Street Lighting.—The Streets and Buildings Committee has decided to carry out a temporary installation of electric light in certain streets previously illuminated by gas. As many electric lamps will be put up as possible, but owing to the dearth of labour, some time will elapse before the scheme is carried out in its entirety.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyne.—The Ashton Master Carriers' Association is seeking an interview with the Corporation with reference to proposals in the Corporation Bill now before Parliament. The Council was granted powers in 1900 to carry goods, and as the Bill provides for linking-up with other tramway systems, the Association is afraid the Council might enter into competition with it. A formal petition has been lodged against the Bill.

Australia.—The financial report on the year's working to June 30th, 1916, of the West Australian Government tramways shows receipts amounting to £118,934; working expenses to £84,780; and a balance of £34,154, representing 6·07 on the capital invested. After deducting interest, £24,927, there remains a net profit of £9,227. The receipts show an increase of £4,913 over the previous year; the passengers carried were 11,243,138, an increase of 443,073; the amount debited for working expenses includes the 3 per cent. contribution to local bodies, £3,543, and £10,000 on account of belated repairs for the purpose of bringing the track and plant up to standard condition. The work in connection with the erection and equipment of the new power house is nearly completed; the buildings have been finished and all the machinery erected, and the completion is now dependent on the installation of the switchgear by the British Westinghouse Co., which has been delayed by the war.—*Commonwealth Engineer.*

Continental.—Spain.—A company has just been formed in Madrid, with the title La Compania del Metropolitano de Alfonso XIII. to construct an underground electric railway in the Spanish capital.

Doncaster.—The Electricity and Tramway Committee reported that the capital expenditure necessary at the termination of the war would amount to £19,050, £10,000 being for doubling the Balby track and £2,000 for car-shed extensions.

Dublin.—Alderman Byrne, M.P., continues to impress on the Government that the Dublin and Lucan Electric Railway should be taken under control, urging that, even on the assumption that the line is a "tramway," other tramways have been taken over, and that, in the event of the closing down of the service, not alone would Government contracts be disturbed, and the tillage scheme outside the city handicapped, but residents along the important Liffey Valley route would be cut off from ready communication with the city.

Exeter.—Accident.—On March 7th, a car, which had got out of control, ran down Fore Street Hill, came into collision with a van, and on reaching the points at the bottom of the hill, overturned, one person being killed and several injured.

Halifax.—The tramway service to Queensbury was suspended at 6 o'clock in the evening on Thursday last week, owing to the wintry conditions.

Ilford.—The Tramway Committee has abolished halfpenny fares and revised the table of fares and stages. The Barking U.D.C. is to be asked for a renewal of the lease of the track on the same terms and conditions as now existing.

Little Hulton.—A deputation of the Council is to urge on the South Lancashire Tramways Co. the need for a better service locally.

Middlesbrough.—Tramway Purchase.—The General Purposes Committee, after special consideration, has reported in favour of the purchase by the Corporation of the local tramway system, provided a satisfactory agreement can be arrived at.

Plymouth.—Price Increase.—The Electricity Committee reported that an agreement had been arrived at with the Tramway Committee for a flat rate charge of 1·56d. per unit for electricity supplied to the tramway undertaking in lieu of the present charges; the new rate represents a slight increase to cover the increased cost of production.

Pontypridd.—Year's Working.—The returns for the year ended March last of the Council's tramway undertaking show that 5,453,421 passengers were carried, and 417,449 car-miles run. The total revenue amounted to £23,118, or rather less than in 1915; and after meeting working and financial charges, a deficit of £2,095 resulted, as against a deficit of £2,271 in the previous year.

Salford.—The Tramways Committee has decided to accept the offer of the boys, about 50 in number, of the Manchester Grammar School, to serve as trolley boys on the cars on Friday evenings and all day on Saturdays and Sundays.

Spen Valley.—Fire.—On the evening of the same day that a car-shed at Castleford was destroyed by fire, as reported in the Electrical Review last week, a fire occurred at the shed belonging to the same company, at Frost Hill, in the Spen Valley, in the course of which two cars were partly demolished and the shed roof destroyed.

Torquay.—The T.C. has accepted an offer from the Tramway Co. to pay £150 instead of an increase of 10 per cent. in price in respect of electricity supplied from Michaelmas to December 31st, 1916.

U.S.A.—Railway Electrification Projects.—The *Electric Railway Journal* mentions that there have been numerous rumours recently of projected electrifications of steam railways in the States. The most notable refers to the Lehigh Valley Railway, which has under consideration the electric operation of the heavier part of its coal tonnage; the total route of 115 double-track miles, including the Wilkes-Barre cut-off and sidings, if electrified will involve an expenditure of, roughly, $20,000,000, and it is stated that a large return on the investment should be possible. It is stated that the engineer's report on the project will be available within a few months.

It is also rumoured that the Chicago steam railway terminals are to be electrified as a sequel to the recently-announced plan of electric operation of the Illinois Central Railway's terminal service.

Legislation has been introduced to provide an hourly electric service on a 10-mile branch of the Boston and Maine Railway between Dover and Portsmouth.

It is also rumoured that the Baltimore tunnel electrification scheme of the Pennsylvania Railway has been revived; this is not credited, though the possibility of electrifying the main line of the Pennsylvania Co. between Baltimore and Washington has been under consideration for several years back.

The intention of the Erie Railway to install electric operation on the Jersey City-North Newark section has been talked about for several years; the preponderance of local passenger traffic is in favour of electrification, but our contemporary doubts whether it is sufficiently heavy to justify the expenditure.

Wigan.—Tower Wagon.—The Tramways Committee proposes to purchase a new tower wagon.

TELEGRAPH and TELEPHONE NOTES.

Cable Breakdown.—The Danish cables between Newcastle and Copenhagen broke down last week.

Guernsey.—The Report of the Guernsey States Telephone Department for 1916 shows that the revenue was £7,565, and the expenditure £7,169, leaving a net profit of £396. Allocations were made to the sinking fund of £393, to the special sinking fund of £379, and to depreciation of £1,529. There were, in all, 2,235 subscribers' and other lines, and the total mileage of lines was 1.555 overhead and 1,060 underground. During the year 1,436,153 local and 3,492 trunk calls were handled, and 9,789 telegrams and letters were telephoned to the Post Office.

Mexico.—The U.S. Government has been semi-officially advised that Mexico City is in direct communication with Germany by wireless. An investigation has been ordered.

Storm Damage.—Telephonic and telegraphic communication between Bradford and Halifax was interfered with last week, many miles of wires being damaged in the hilly country about Queensbury by the effect of a gale of wind, and also by the breaking of wires by the weight of ice.

The fierce weather played havoc also with the telegraph and telephone wires just beyond the Summit, Manchester Road, Burnley. The main wires between Burnley and Manchester go over this exposed height, and the poles and wires meet the full force of the wind. Many of the poles were blown down and the wires badly broken. The wires were found coated with ice.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—U.D.C. Electricity Department. Battery of accumulators complete. See "Official Notices" to-day.

Australia.—ADELAIDE.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

Bolton.—March 19th. Tramways Committee. Twelve months' supply of overhead materials, carbons, insulating materials, &c. Mr. J. Barnard, General Manager.

Bristol.—March 22nd. Six or twelve months' supply of unwashed small coal (with alternatives for washed pea coal) for the electricity works. Mr. H. Faraday Proctor, Chief Engineer and Manager, The Exchange, Corn Street.

Burnley.—March 19th. Electrical goods, for the Board of Guardians. Mr. J. S. Horn, Clerk.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Dundee.—March 28th. Corporation. Twelve months' supply of electrical stores, &c. Specifications from the Electricity Department, Dudhope Crescent Road.

Glasgow.—April 5th. Corporation. Turbo-alternators (15,000 KW.), transformers, and condensing plant for the new generating station at Dalmarnock. Particulars from Mr. W. W. Lackie, Chief Engineer and Manager, 75, Waterloo Street, Glasgow.

Liverpool.—March 19th. Electrical supplies for three months, for Toxteth Park B. of G. Mr. R. A. James, Clerk, 15, High Park Street.

London.—ST. PANCRAS.—April 12th. B.C. Arc lamp carbons. See "Official Notices" March 9th.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Rhondda.—March 21st. U.D.C. Twelve months' supply of house-service meters. See "Official Notices" March 2nd.

Salford.—March 19th. Electricity Department. 5,000 tons of washed slack coal during the next six months. Borough Electrical Engineer.

Spain.—The municipal authorities of Caceres have just invited tenders for the concession for the electric lighting of the town during a period of 15 years. Tenders have also been lately invited by the municipal authorities of the town of Carabanchal (Province of Madrid) for the lighting concession during an unnamed period.

Warrington.—April 11th. Electricity and Tramways Committee. One 3,000-KW. turbo-alternator and surface condensing plant. See "Official Notices" to-day.

CLOSED.

Bexley.—U.D.C. Sub-station for power plant installation at East Wickham: D. Rowell & Co., Westminster, £104 10s.

Bradford.—Corporation. National Rail and Tramway Appliances Co., Ltd., 100 tons of cast-iron brake blocks for the year.

St. Helens.—Electricity Committee. Amended tender of Messrs. Babcock & Wilcox for two new boilers.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Papers on "Heat Treatment of Large Forgings," by Sir Wm. Beardmore, Bart.; and "Heat Treatment of Steel Forgings," by Mr. H. Hashdown.

Electro-Harmonic Society.—Friday, March 16th. At 8 p.m. At the Holborn Restaurant, W.C. Smoking concert.

Association of Mining Electrical Engineers.—Saturday, March 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Maintenance of Underground Plant," by Mr. M. Baird, jun.

Institution of Post Office Electrical Engineers (London Centre).—Monday, March 19th. At 6 p.m. At the Institution of Electrical Engineers. Paper on "The Provision of a Telephone Exchange," by Mr. G. F. Greenham.

Institution of Civil Engineers.—Tuesday, March 20th. At 5.30 p.m. At Great George Street, S.W. Paper on "The New Electric Power House at Birchills, Walsall," by Mr. E. M. Lacey.

Liverpool Engineering Society.—Wednesday, March 21st. At 7.30 p.m. At the Royal Institution, Colquitt Street. Joint meeting with the Manchester Section of the Institution of Electrical Engineers. Paper on "Equipment of King George Dock, Hull," by Mr. L. Leighton.

Institute of Metals.—Wednesday, March 21st, and Thursday, March 22nd. At 36, Victoria Street. Spring meeting.

Institution of Electrical Engineers.—Thursday, March 22nd. At 8 p.m. At Victoria Embankment, W.C. Paper on "Machine Switching Telephone Gear," by Mr. F. R. McBerty.

(Scottish Local Section).—Tuesday, March 20th. At 7 p.m. At Princes Street Station Hotel, Edinburgh. Paper on "Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

(Manchester Local Section).—Wednesday, March 21st. At 7.30 p.m. Joint meeting with the Liverpool Engineering Society at the Royal Institution, Colquitt Street. Paper on "Equipment of King George Dock, Hull," by Mr. L. Leighton.

(Yorkshire Local Section).—Wednesday, March 21st. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "The Voltage Regulation of Rotary Converters," by Mr. G. A. Juhlin.

Royal Institution of Great Britain.—Thursday, March 22nd. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Modern Improvements in Telegraphy and Telephony: Telegraphy" (Lecture I), by Prof. J. A. Fleming, F.R.S.

Greenock Electrical Society.—Thursday, March 22nd. At 7.45 p.m. At 22, West Stewart Street. Paper on "Electric Welding," by Mr. D. Angus. Saturday, March 24th. Visit to Gateside Colliery, Cambuslang.

NOTES.

Electrically-tempered Tools.—A recent issue of the *Electrical World* contains some interesting data regarding the cost of tempering steel tools electrically in an American automobile manufacturing plant. The furnace was operated 98·5 hours on 19 days, or 5·18 hours per day; in that time, 1,978 high-speed steel tools, consisting of circular cutters, reamers, reamer blades, keyway cutters, taps, circular form tools, thread chasers, profile cutters, pointing tools, hollow mills, &c., were treated, at a cost of 826·6, with energy at 3 cents per KW.-hour.

Adding the cost of renewing the carbon heating elements, 84·48, the total cost for the period becomes $31·11, or 1·57 cents per tool.

During five runs, 352 lb. weight of tools were treated, at a cost of 2·33 cents per lb. These tools are treated in a Hoskins F.C.-204 furnace, with internal dimensions of 6½ in. × 5 in. × 11 in. and maximum rating of 15 KW.; with temperatures of 2,100° to 2,300° F., the average demand is 9 to 10 KW. The accurate control of temperature and furnace atmosphere is a great advantage, because the better the tool the greater the efficiency of the machine. Improper temperature treatment may result in a difference of from 30 to 70 per cent. in the life of the tool.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters: Balderton Street, Oxford Street, W.

Saturday, March 17th.—The Parade for Route March will be 2.45, Golder's Green Station.

Monday, March 19th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, March 21st.—Instructional Class, 8 15. Platoon Drill, Platoon No. 1.

Thursday, March 22nd.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, March 23rd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.30—8.30.

Saturday, March 24th.—N.C.O.'s Instruction Class. Captain Castell, Bridging.

Sunday, March 25th.—Special work at Bombing School. Parade Clapham Junction Station (City & S.L. Tube Ry.), 9.45 a.m.

Easter Training will be at Esher. Names can still be sent in.

(By order), MACLEOD YEARSLEY, *Captain and Adjutant.*

The Metric System.—We are informed by the Decimal Association that a Weights and Measures Bill, drafted by the Associated Chambers of Commerce, is now being circulated throughout the country for consideration and criticism.

Although nothing of the kind has happened in any "metric" country, some British manufacturers fear that the compulsory adoption of the metric system in this country would necessarily involve the immediate scrapping of all their existing machinery, patterns, tools, and other workshop standards. It should therefore be known that to overcome this difficulty the following clause has been inserted in the Bill:—

4 (*a*) "Provided that nothing in this Act shall affect the manufacture or use of any machinery, tool, pattern, sieve, template, or other article made by measures other than metric measures."

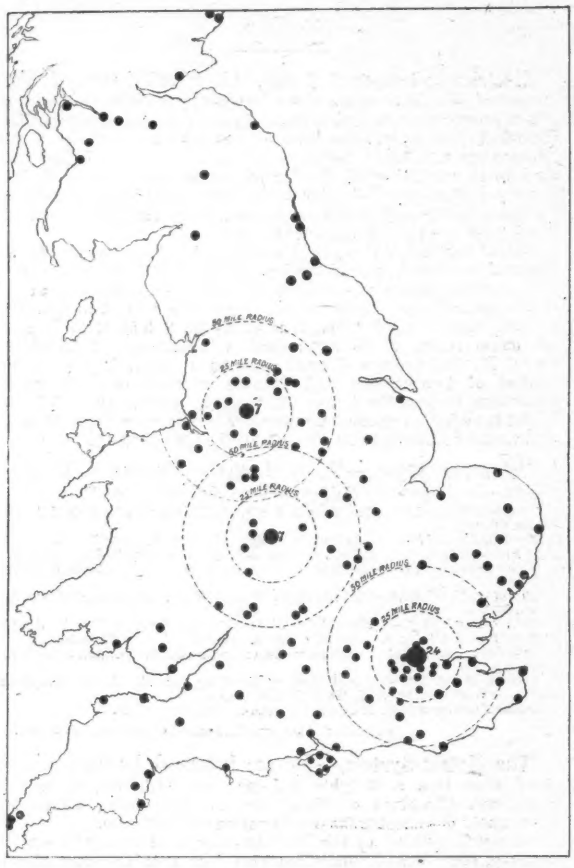
The passing of an Act on the basis of the proposed Bill would thus mean that, while we should all be required to buy and sell in metric quantities, we should be at liberty to continue the use of our existing weights and measures for manufacturing purposes until such time as we ourselves chose to amend them.

The Coventry Chamber of Commerce, at a special meeting held for the purpose of considering the draft Bills of the Association of Chambers of Commerce for the introduction of decimal coinage and metric weights and measures, has passed a resolution approving of the Coinage Bill, and also of the Weights and Measures Bill, with the proviso in the latter case that the time of change be extended to three years from the passing of the Act.

Late Legal.—H. S. BARRETT *v.* THE ENFIELD ELECTRIC CABLE MANUFACTURING CO., LTD.—Before Mr. Justice Ridley, on Tuesday, Mr. H. S. Barrett, an architect, sought to recover from the defendant company £115 10s., fees for professional work done for the defendants, the main portion of the fees being in connection with the preparation of plans for a new factory at Brimsdown for the defendant company. The defence was that a verbal agreement was made between the plaintiff and Lord Grimston, acting on behalf of the defendants, by which the plaintiff was to prepare the plans at his own risk. If the work was afterwards carried out plaintiff was to be paid for his services, and if not (as did happen) he was to receive nothing. In the result, the defendants agreed to submit to judgment for £105, to include £10 10s. paid into Court, with costs on the High Court scale. Judgment was entered accordingly.

Commercial Electric Vehicle Investments in the U.S.A.—From figures supplied by Mr. W. P. Kennedy to the Electric Vehicle Section of the N.E.L.A., it appears that the estimated value of commercial electric vehicle equipments in use (presumably in the States) is roughly 36 million dollars (or over £7,000,000). Brewers and department stores each figure at some 6 million dollars, public service companies at 4 million dollars, express companies at 3½ million dollars, and manufacturers' and merchants' industrial trucks at 2¾ million dollars.

Charging Stations for Electric Vehicles.—In our last issue we referred to the official list of stations at which the batteries of electric vehicles can be charged, which has been prepared by the Electric Vehicle Committee, and embraces about 180 names of places. The list in itself is of importance, as marking the growth of opinion favourable to the use of such vehicles; but its significance can be far better appreciated from the small map which



we publish herewith, and which indicates at a glance the situation of these charging stations with regard to each other—which is obviously of more importance to the user than mere numbers, if the full advantages of the electric vehicle are to be realised.

The London County Council area can now boast of some two dozen public charging stations, sprinkled well over the area, and we would suggest that the metropolitan users would better appreciate their possibilities if they were shown diagrammatically on a map, which could be published with the list of charging stations.

The Metric System in the U.S.A.—During the sixty-ninth meeting of the American Association for the Advancement of Science in New York, during Christmas week, 1916, a conference was held, designated the "Metric Conference," at which were present representatives of national business organisations, the United States Department of Commerce, and men prominent in engineering and educational work. The object of this conference was to discuss the Pan-American use of the metric system. Its outcome was the formation of a permanent organisation to be known as the American Metric Association, to further the adoption of the international metre, gramme, and litre, which have been legalised in the United States since 1866.

The Association maintains an office at 156, Fifth Avenue, New York, and is especially desirous of receiving catalogues of manufacturers who use the metric system for domestic or export purposes.

War and Industry.—In an address delivered to the members of the Delphian Coterie, at the Cannon Street Hotel, London, on the 7th inst., Mr. Samuel Turner, of Rochdale, joint author with Dr. Gray of the work "Eclipse or Empire," made certain refetences to the effect of the war upon various departments of British industry. The war had undoubtedly given us a great creative impulse, which had for result that during the war period this country had, he believed, invented more, developed more, and achieved more by way of industrial and scientific organisation and reconstruction than in the previous 20 years. Thus they saw the logical position which research and experimentation might occupy. As regards methods in other countries, they saw that Germany had forty chemists to our one; the United States had a like preponderance of mechanical experimenters; Columbia University had a new laboratory in prospect to cost £125,000, with an endowment of £500,000; the Bureau of Standards employed 400 men, 75 per cent. scientists, and spent £120,000 a year. The Bell Telephone Co. had 300 experts whose sole job was to improve the telephone; the Western Electric Co. had 1,000 men in the laboratory, and the results of these two particular phases of activity were that America controlled the telephone business of the world, in so far as she supplied three-fifths of the apparatus, and everyone who knew America realised that she had a telephone service, and we had not. Our service was really a joke in comparison with that of America, and he doubted whether there were in this country a score of men who were solely engaged in trying to improve the telephone service. But the two companies named had 1,300 men doing nothing else, consequently the technique of the industry had passed to America. The Pennsylvania Railroad had 360 men in their laboratory, and spent £100,000 a year. The General Electric Co. spent a like amount, and had 200 men in laboratory work. The Westinghouse Co. spent £70,000, the Eastman Kodak £30,000, and the Goodrich Tyre Co. £20,000 annually. And why all this? Simply because these people believed in the evolutionary and dynamic nature of industry, and had not been content to wait for things to happen. They had planned and worked for the future, just as steadily as they did for present-day requirements. People asked him what about the cost of this kind of thing. Well, the experience was that the cost did not really enter into the calculations, because these laboratories were found to pay for themselves. That was not theory, but actual practice. The evidence was overwhelming in demonstration of the necessity of adopting scientific methods in industry in this country. Industries must also be so organised that they would bring greater leisure and prosperity for the workers. The evidence on all hands was conclusive that the country which adopted scientific methods and efficiency, and went in for high production and high wages, was a better place for the worker to live in than a country which was industrially inefficient.

Employers and National Service.—A deputation, representing the Federation of British Industry, the British Manufacturers' Association, the Association of Controlled Establishments, and the Employers' Association waited upon Dr. Addison and Mr. Neville Chamberlain, at the House of Commons, on Wednesday. These bodies, it is estimated, represent three-quarters of the manufacturing firms in the country. The classification of the non-essential trades, and orders relating thereto, were the principal subjects under consideration. Mr. George Terrell, M.P., who introduced the deputation, said that they represented between 8,000 and 9,000 manufacturing firms, employing many millions of workpeople, and he urged that if employers were taken into the confidence of the Government, they would probably be able to meet the requirements of the country with a minimum of interference with output. Dr. Addison intimated that a Consultative Committee, with members nominated by the employers of labour, would be set up.—*Times.*

Radium and Food for Cattle.—Writing to the *Financial Times*, Mr. Barton Scammell, M.S.C.I., President of the Society for Radiumising the Soil, says:—In the words of the Prime Minister, "we have a larger stock of cattle than I think we ever had before in this country," and therefore any addition to our supplies of food for cattle is of national importance. This addition can be provided by the new discovery of science that the solutions of radio-active matters will convert cellulose (sawdust, &c.) into an assimilable starch-like material, of which as much as 50 per cent. in finely-powdered form can be mixed with the ordinary foodstuffs, the cost working out at under £3 per ton, and forming a fattening and nourishing food for pigs, cattle, and poultry. The typical cellulose is represented by the formula $C_6H_{10}O_5$, identical with that of starch, with which it has many chemical analogies.

The Engineers' Club.—The membership of the Engineers' Club, Manchester, is now 753. After allowing for resignations, deaths, &c., the net increase for the year is 70. The Club has elected Alderman T. Smethurst (the Lord Mayor of Manchester) to be its first honorary member, in recognition of his services to the engineering industry. The Club Roll of Honour bears the names of 73 members and six of the staff of the Club. Mr. E. L. Hill resigned the honorary secretaryship early in January, 1917, owing to his now residing in London; Mr. H. T. Wilkinson has been appointed to succeed him. The balance sheet shows the funds of the Club at £2,257, less "deficit on trading account from 1613 to 1916 inclusive, £108." And yet we had a dim recollection of this Club being formed since we were born.

Use Solid Wire in Place of Small Stranded Cable.—The Council of the Incorporated Municipal Electrical Association having considered the letter of the Cable Makers' Association to which we referred in our issue of March 2nd, has passed the resolution given below, and recommended the members of the I.M.E.A. to agree to it:—

"That in view of the demand by the Government for small stranded wires being so great, the restrictions as to the use of single-strand conductors of 18 s.w.g., 16 s.w.g., and 14 s.w.g. should be temporarily suspended during the war, and that the use of such for installation wiring in place of 3/22 and 7/25 s.w.g., 3/20 and 7/23 s.w.g., and 7/22 and 7/21½ s.w.g. respectively be accepted."

Night Ploughing by Electric Light.—According to local papers, the Government is sending out electric lighting sets in connection with night ploughing operations in Yorkshire, where it is intended to use from 100 to 150 motor-ploughs and tractors.

Institution and Lecture Notes.—Institution of Electrical Engineers.—Prior to the meeting of the Institution on Thursday, last week, the president (Mr. C. P. Sparks) announced the probability of H.M. Office of Works taking over the Institution building, in which case arrangements would be made to hold the meetings elsewhere.

Association of Draughtsmen.—The Association of Engineering and Shipbuilding Draughtsmen (London Branch) held its first general meeting on Saturday last, when officers and Council representative of the various firms in the district were elected to carry on the work of the Association within the London area. There were present about 150 members out of nearly 350 members, composing the London Branch, and this membership is increasing week by week. Discussion on the future business of the Association ensued, and Mr. L. Blair, the general secretary of Glasgow, gave a short account of the work of the Association during the past year. The total membership of this Association is now over 5,000, enrolled from all branches of engineering and shipbuilding in Great Britain and Ireland. The address of the honorary secretary of the London Branch is 38, Craster Road, Brixton Hill, S.W.2.

Birmingham Electrical Club.—There was a large attendance at the seventh annual dinner of the club, which was held under the chairmanship of Mr. A. B. Mudie (president). An excellent concert was given.

Nottingham Society of Engineers.—On Wednesday evening, Mr. David Rushworth gave a lecture (with 100 special slides) on "The Fuel Economiser."

Royal Dublin Society.—A lecture was delivered recently by Prof. J. A. McClelland, F.R.S., on "Radiations."

Engineers' Wages.—It is stated by Mr. J. T. Brownlee that the recent wages award in the engineering trades will affect 1,000,000 persons, and cost £12,000,000 as an annual increase in the wages bill.—*Westminster Gazette.*

Appointments Vacant.—Working foreman, also shift engineer (40s.), for the Guildford Electricity Supply Co.; mains superintendent and shift engineer for the Neath R.D.C. electricity works. See our advertisement pages to-day.

Fatality.—JOHANNESBURG.—An electrician employed at the Victoria Falls power station at Vereeniging, whilst engaged in dusting portions of a switchboard with a feather duster, made contact with an 80,000-volt conductor; he was shockingly burned and succumbed to his injuries.

Nitric Acid in Sweden.—A new company, with large capital, has been formed for the manufacture of nitric acid and other chemical products in Sweden, according to the *Chemical Trade Journal*. It has entered upon a contract with the Royal Waterfalls Board for a supply of electrical energy, and the works will be erected on the area reserved for industrial installations at Trollhattan. The annual capacity will be some 7,000 tons of concentrated nitric acid, with nitrates as an auxiliary product. The new company will use the Birkeland-Eyde method, for which rights have been secured for Sweden. The work is being pushed ahead with all speed to be ready this year.—*Metallurgical and Chemical Engineering.*

REVIEWS.

Groupes Electrogènes en régime troublé. By L. BARBILLION. Paris: Gauthier-Villars et Cie. Price 11 fr.

This work chiefly consists of a series of lectures delivered by Prof. Barbillion at the University of Grenoble during the session 1912-13. The book was ready for publication in June, 1914, but owing to the war, and to the fact that the author was called up during the first days, its appearance has been delayed. It deals with the functioning of what he calls "groupes électrogènes," that is, with combinations of at least two machines, one of which is a generator of electricity and another a motor of any kind driving it. The question of the regulation and governing of such groups is gone into very thoroughly from the theoretical point of view, mathematical and graphical methods being both employed. Large numbers of diagrams are incorporated in the text.

Principles of Electrical Design. By ALFRED STILL, Professor of Electrical Engineering, Purdue University. London: Hill Publishing Co. Price 12s. 6d. net.

In the preface the author emphasises the fact that the book is intended for the use of students rather than for the use of designers working under commercial conditions. With this end in view, greater stress is laid on the principles underlying design and on the methods to be used to achieve certain results than on short methods, based largely on personal experience, used by many commercial designers.

In an introductory chapter the author points out to would-be designers the importance of an accurate knowledge of theory and of acquiring the spirit of initiative and research: the necessity of attaining power of expression, both verbally and by diagrams, and the acquisition of what is termed engineering judgment are also rightly insisted on.

No attempt is made in the book to deal with the whole field of electrical design. The ground covered includes electromagnets, direct-current dynamos and motors, and alternators; another volume, dealing chiefly with induction motors and converting plant, would be valuable.

In perusing the book, the outstanding feature, to which the attention of the reader is repeatedly drawn, is the importance the writer attaches to the study of the actual flux distribution (particularly in the gap) under working conditions. He points out that while shorter and easier methods may give results sufficiently accurate for the designer when dealing with standard or normal machines, the flux-distribution method is the only safe way of dealing with new designs or with machines working under abnormal conditions. This idea of flux distribution is used very clearly in connection with the calculation of the additional ampere-turns required on the field of a direct-current generator when load is increased. Put very briefly, the method in such a case consists of first determining the flux distribution when the machine is generating the necessary pressure on no load. The resultant distribution of ampere-turns on the gap is then found under full-load conditions, and the consequent flux deduced. The total flux produced is, of course, lower than on no load, and gives a lower generated pressure. Finally, the flux on load is increased in the necessary proportion (not forgetting to allow for resistance drop in the armature, &c.) to give the required terminal pressure on load, and the increase in field ampere-turns above those necessary for the no-load condition is then readily ascertained.

A similar procedure is recommended in the case of alternator regulation, though a vector method for attaining the same end is also considered at length.

The chapter dealing with commutation in direct-current machines is also written on lines which differ from those usually followed, and affords much food for thought. Questions of heating, ventilation, energy losses, and efficiency are dealt with on normal lines in an adequate manner.

The arrangement of armature windings, both for direct and alternating-current machines, is always a source of difficulty with students, and it would seem that the space devoted to the subject might be increased in subsequent editions with advantage. A considerable number of tables of constants, derived from modern commercial experience, are inserted in the book, and these will be especially useful to students who are unable to find such data in their personal experience.

Such criticisms of the book as can be made relate merely to minor points, and in this connection it is to be noted that the writer, when dealing with magnetic circuits, uses the gauss as the name of the unit of strength of magnetic field; it is perhaps largely a matter of opinion, but it seems better to use the line per sq. cm. as the name of the unit of field strength, reserving the gauss as the name of the unit of magnetising force.

The diagrams are clearly drawn and adequately serve their purpose; the only suggestion that can be made is that in all vector diagrams the direction of rotation of the vectors should be specifically indicated by a curved arrow.

The book is thoroughly worth the attention of all men engaged in the design of heavy electrical machinery and of all teachers of electrical engineering. Students in technical universities will also profit considerably by a perusal of the book in the later part of their course.

Practical Safety Methods and Devices. By G. ALVIN COWEE. London: Routledge & Sons, Ltd. Price 12s. 6d. net.

It has been rightly said that even with the most highly trained workers and under the best conditions there is always present the human liability to err. A moment's inattention, a sort of mental air pocket, so to speak, and a mistake is made which may have the most tragic consequences. Especially is this the case at the present time, when a large amount of ill-trained and even unskilled labour is working under contions which are far from approaching the ideal with material which may contain in itself all the elements necessary for a great and terrible disaster. Accidents, wherever and whenever they occur, are almost invariably due to some slip on the part of someone, more often than not the victim, which not only need not have been made, but which he had been deliberately avoiding making until the avoidance had become a habit, a second nature as it were, and so had given rise to the momentary relaxation of the watchfulness necessary for safety.

At the moment it is Utopian to hope for the avoidance of accidents altogether, so that all we can do that is likely to be of practical value is to consider how they can be reduced to a minimum. There is not the slightest doubt as to the avoidability of the great majority of accidents; that being so, what we have to find out are the best precautions that can be taken against their occurrence. Here, again, is the human element to be considered. No mechanical protection to any form of machinery can be regarded as efficient unless the worker understands exactly why it is necessary and recognises its true value. In connection with this, cases will at once come to mind where safety devices have been either ignored or in some cases put deliberately out of action by the very people they were designed to protect.

He would be a bold man who would say that he considered the limit had been reached in regard to safety or protective devices; many experimentalists are still engaged in thinking out schemes and designing safeguards which shall still further promote the immunity of the worker from accident. The tendency is for more and more attention to be paid towards ensuring the safety of the worker; in fact, it may be said that the modern motto is "Safety first." It has been calculated that in the United States some 35,000 lives and some £100,000,000 are lost every year in preventible accidents in factories and workshops. It has been recognised in that country that the most important factor in the elimination of avoidable accidents is the education of the employés, and it has been stated that the United States Steel Corporation, by giving proper attention to the human element as well as by adopting the best safety devices, have during the past five years brought down their accident rate by forty per cent.

Mr. George Alvin Cowee, in his work "Practical Safety Methods and Devices," gives an excellent description of the "Safety First" movement in that country, which is carried out, so far as the education of the workers is concerned, by what are called Safety Committees. Although safety methods have been systematically studied for a number of years on the Continent, the fallacy has largely prevailed in America that all work accidents were necessarily incidental to industry and that casualties were more or less inevitable. Comparatively few employers and safety engineers, together with the accident indemnity companies, says Mr. Cowee, have clearly demonstrated that this assumption is incorrect; furthermore, that it is possible, practicable, profitable and eminently humane to prevent this large proportion of industrial accidents.

Many of the large industrial corporations in the States utilise the kinematograph to illustrate the dangers which the employés should avoid. A number of others pin their faith to pamphlets which are replete with photographs and drawings. Some award a "Safety First" button to the men who have passed an examination, chiefly if not wholly oral, in the rules which have been adopted by the company. It may be doubted whether this would commend itself to the British mind, but still it is only one of many suggestions and practices, and the author appears to pin his faith to the adoption of safety committees. These consist of several workmen in each department, and periodical meetings are held for the discussion of accident prevention. A safety inspector is appointed for each section by the workmen concerned, and it is his duty to caution everyone whom he may notice adopting unsafe methods, and to report upon every unsafe place and every insufficiently guarded machine. The Dodge Manufacturing Co., it has been mentioned, uses an accident prevention score board, on which the employés are divided into sections, and the accidents in these are duly registered. A premium is given to the sections which come out best at the end of each year. This strikes one as being a scheme which might be adopted with advantage by the larger British manufacturing concerns. The United States Steel Corporation are said to find that the saving in casualty expense over expenditure for safety during the last three years has been over 35 per cent., while, on the workers' side, must be estimated the amount saved in wages.

The book is intended to provide for employers, superintendents, underwriters, and engineers generally a convenient summary of standard safety methods and devices as developed and perfected by those who have specialised in that direction. It is the result of careful observations made in hundreds of mills and manufacturing establishments, and reflects the experiences of hundreds of practical men. Amongst the subjects dealt with are safety devices and appliances for electric supply work, electric traction, and electric power. Steam railways, mechanical engineering works, machine tools and grinding, and wood-working machinery are all dealt with from the safety-first standpoint, and in addition there are valuable chapters on welfare work, sanitation, fire drills, first-aid, and other subjects likely to be of interest and value. The book can be confidently recommended, and will be of value to all who study its pages.

Applied Electricity for Practical Men. By Arthur J. Rowland. London: Hill Publishing Co. Price 8s. 4d.

"The book is offered to the public in the hope that it may fill a need in connection with the study of applied electricity in trade and industrial schools, and that the explanations may be helpful to electrical workers everywhere." It is seldom that a book which sets out to "fill a need" so adequately fulfils its purpose, but a careful perusal of Mr. Rowland's book leaves little doubt that it will appeal to a very large public, and that whoever buys the book will at least be satisfied that it does all that it professes to do.

The writing of a text-book for practical men on *any* subject involves considerable difficulties, but the breadth of the subject, and the absolute necessity for some form of mathematical treatment in some parts of applied electricity render the preparation of a text-book such as the one under review a task beset with obstacles of an unusual character. There is always the possibility of slipping into the superficial method of treatment in order to cover the whole gamut of things electrical, from the elementary phenomena of frictional electricity to wireless telegraphy and X-rays. And, on the other hand, there is the temptation to deal too much with principles and leave no room for the application of principles to practice. Mr. Rowland has fortunately succeeded in avoiding both of these extremes, and has written a well-balanced, common-sense book which is neither superficial nor too theoretical.

In the first chapter he deals with the fundamental principles of current electricity, and gives some practical ideas of the magnitude of currents used for various purposes, such as glow-lamp lighting, electric train propulsion, &c. He then passes on to discuss electromotive force and Ohm's law, illustrating every principle by reference to modern electric practice. This, together with a concise chapter on the phenomena of magnetism, leads immediately to a study of the D.C. dynamo. Mr. Rowland has succeeded in two chapters in giving a remarkably full account of the principles, construction, and working of the modern dynamo. Special attention has been given to the winding of armatures, and it is evident from the examples given at the end of the chapter that the author has aimed at no superficial knowledge.

A short chapter is given up to electric heating, and this is followed by a long one on systems of power distribution, including switchboards and switchboard instruments. The latter chapter is an excellent one, and the illustrations are also excellent. D.C. motors are then studied, and, after a further chapter entitled "More Principles," alternating currents are dealt with very completely in half a dozen chapters. Transformers, alternators, polyphase circuits, and A.C. motors are treated in turn, and here, again, the perusal of the text and reference to the examples which follow each section indicate a thoroughness of treatment unusual in a text-book which has so plausible an excuse for superficiality—that it is written for practical men.

The three remaining chapters do not fall short of the promise of the early part of the book. The sections on storage batteries and electric lights are well planned essays on large subjects, designed to give a maximum of accurate and up-to-date information in a short compass; and the final chapter on wires and wiring is equally satisfactory, except that its usefulness to English readers is impaired by the use of the "circular mil" in stating sectional areas of wires.

As we have already indicated, the author has succeeded in producing a book on applied electricity of undoubted usefulness, and we heartily recommend it as a text-book for trade and technical classes in electrical engineering, and as a useful handbook for all classes of electrical workers.—P. H. S. K.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. J. Watkin, accountant to the Urban Electric Supply Co. at their Grantham Works, on leaving for another appointment, has been presented by the staff with a fountain pen and walking-stick.

Mr. G. E. E. Williamson, second charge engineer at the Ilford electricity undertaking, has resigned. Mr. A. Glazier, third charge engineer, has been promoted to the vacancy at £150 per annum.

Mr. Salt, electrical engineer to Torquay Corporation, has been promoted to the rank of full lieutenant in the Army.

The Halifax T.C. has resolved to increase the salary of the tramway traffic manager from £400 to £425, and that of the tramway engineer from £300 to £325 per annum, but has referred back to the Electricity Committee, for consideration along with the estimates for next year, a proposed advance to the electrical engineer from £700 to £800.

The West Hartlepool T.C. has decided to grant a sum of £105 to Mr. J. W. Spark, acting general manager of the tramways, for his services during the past 18 months in the absence of the manager, Mr. C. Burgess, on military service.

The directors of the Clyde Valley Electric Power Co. have appointed Mr. Arch. Page, Glasgow, to be assistant general manager of the company. Mr. Page has been in the employment of the Glasgow T.C. electricity department for the past 18 years, having acted for 12 years as deputy chief engineer and manager. At the last meeting of the Scottish Local Section of the I.E.E., Mr. Page was nominated as chairman of the Section for next session. For several winters he was president of the Students' Association of the Section.

The General Purposes Committee of the Cape Town Corporation has recommended that Mr. G. H. Swingler be appointed acting electrical engineer in the place of Mr. J. W. S. Clunas, who recently resigned. The appointment is for a period of six months at a salary of £750 per annum. Mr. Swingler has recently been acting as assistant electrical engineer to the Corporation, and previously was electrical engineer to the Municipality of Murzenberg, now amalgamated with the Cape Town Municipality. In connection with Mr. Clunas's resignation, presentations were made to him of a gold watch by the office staff, of two silver entrée dishes by the running and maintenance staff, and of a combined cigarette and sovereign case by the coloured workmen.

General.—Mr. R. B. Dunwoody, A.M.I.C.E., secretary to the Association of Chambers of Commerce, has been appointed Secretary of the Board of Trade Canals Committee. His address will be 7, Princes Street, Westminster, S.W. 1.

Mr. E. G. Peill, director of the Bromley (Kent) Electric Light & Power Co., Ltd., has been elected an alderman of the Town Council.

A new board of four commissioners has been appointed by the New South Wales Government for the control and management of the railways, as follows:—Mr. J. Fraser, chief commissioner; Mr. E. Milne, deputy-chief commissioner; Mr. J. H. Cann and Mr. H. Fox, commissioners.—*Commonwealth Engineer.*

On Wednesday last week, the Manchester City Council agreed to the proposal to increase the salary of Prof. Miles Walker, Professor of Electrical Engineering at the Manchester School of Technology, to £1,200 per annum by three equal instalments of £200 on April 1st, 1917, 1918, and 1919. Sir Thomas Shann spoke of the ability of Prof. Miles Walker, and said he had been offered £1,800 a year to take control of an electrical engineering concern working entirely in the national interests.

Sir Home Gordon, the Controller of the Staff of the National Service Department, is a director of the Electric Supply Corporation, Ltd. Major G. C. Hamilton, M.P., who is Director of Enrolment to the Department, was a joint managing director of Messrs. Drake & Gorham, Ltd., until he took up military duties in 1915.

Mr. H. W. Albrow announces that his position as manager with the Electrical Co., Ltd., has come to an end owing to the winding up of the business by order of the Board of Trade. An advertisement regarding his movements appears on another page.

On February 10th, a banquet was held in the States to celebrate Mr. T. A. Edison's 70th birthway. The American *Electrical Review* quotes the following message sent by President Wilson:—

> I wish with all my heart that I might be present to take part in celebrating Mr. Edison's 70th birthday. It would be a real pleasure to be able to say in public with what deep and genuine admiration I have followed his remarkable career of achievement. I was an undergraduate at the university when his first inventions captured the imagination of the world, and ever since then I have retained the sense of magic which what he did then created in my mind. He seems always to have been in the special confidence of Nature herself. His career already has made an indelible impression on the history of applied science, and I hope that he has many years yet before him in which to make his record still more remarkable.

Roll of Honour.—Sergeant Green, who was on the staff of the Isle of Thanet Electric Traction & Lighting Co., Ltd., has fallen in action at Kut.

Lieutenant-Colonel A. B. Layton, A.M.I.E.E., of the South Lancashire Regiment, for 14 years electrical engineer to Messrs. Joseph Crosfield & Sons, Ltd., of Warrington, has been mentioned in dispatches.

Private John Giblin, K.O. Royal Lancaster Regiment, killed in action, was employed by the British Westinghouse Co., at Trafford Park.

Acting Staff-Sergeant J. W. Clayton, formerly a motorman on the Burnley Corporation tramways, has been awarded the Meritorious Service Medal.

The many friends of Mr. Percy Rosling (W. T. Henley's Co.) will desire to join with us in expressing sympathy with him in the loss of his elder son—Alan Percy Rosling, Second Lieutenant, Worcestershire Regiment—who was killed in action on March 4th.

Charles Henry Harper, R.E., who has died at the Front at the age of 41, served his apprenticeship with the Telephone Co. in Dundee. He afterwards went to Manchester, and subsequently to Madras, where he held an appointment for seven years with the Oriental Electric Co. Returning to this country, he entered the telephone service in Glasgow, where he was employed up to the outbreak of war.

Intimation has been received of the death from wounds, on March 6th, of Captain Norman C. Lowson, M.C., R.E., the only son of Mr. James Lowson, senior partner of the firm of Messrs. W. C. Martin & Co., electrical engineers, Glasgow. Captain Lowson was a member of the O.T.C. at Glasgow Academy, and afterwards at the University, where he graduated B.Sc. in engineering. While studying, he served for short periods with the Glasgow T.C. electricity department, with Messrs. Drysdale & Co., Yoker, and the Albion Motor Car Co. He was subsequently a year with the British Electric Plant Co., Alloa, leaving that firm before the outbreak of war for training with the Special Reserve of Officers, and at the outbreak of hostilities he was in command of the 7th Divisional Signalling Company, Chatham. Captain Lowson was mentioned in dispatches for services at Neuve Chapelle and at Loos, and was awarded the Military Cross.

The *Times* records the death in Leeds, on March 6th, of Colonel F. W. Tannett-Walker, R.E., who had been for 12 months in command of a battalion of Royal Engineers in France. He was a member of the Institution of Civil Engineers, and for many years a director of Tannett Walker and Co., engineers, Leeds.

Obituary.—Mr. E. Kay.—The death is announced of Mr. Edward Kay, electrical engineer, of Bury (Lancs.), aged 52 years.

Mr. S. Charlesworth.—The sudden death has occurred of Mr. Sheard Charlesworth, electrical engineer, of Oldham. Mr. Charlesworth, who was in his 57th year, was until 1894 partner in the firm of Messrs. Charlesworth, Hall & Co., electrical engineers, and on the partnership being dissolved he went into business for himself in Clegg Street.

Mr. H. L. Elward.—The death has occurred of Mr. Henry L. Elward, A.M.I.E.E., one of the oldest members in Ireland of the Institution of Electrical Engineers, who had been for a quarter of a century connected with the Dublin Corporation electrical department, and was previously associated with electrical schemes in London, Eastbourne, and Madrid.

Mr. A. E. White.—The death has occurred, at the age of 61 years, and after a long illness, of Mr. A. E. White, M.Inst.C.E., who was for 28 years city engineer at Hull. He was responsible for the special character of the tramway track construction, which saved the city a great deal of money.

Mr. D. Huntley.—We regret to learn of the death, which occurred on 6th inst. from pneumonia, of Mr. David Huntley, A.M.I.E.E., who was for many years chief engineer and works manager of the Dowsing Radiant Heat Co., Ltd. Mr. Huntley commenced his electrical career at the age of 17 as a pupil of Mr. H. J. Dowsing, M.I.E.E., in his private practice, and remained with him when the business developed into the Dowsing Radiant Heat Co., Ltd. He represented the firm in the Electrical Section of the B.E.A.M.A., of which he was chairman. He was a man of great energy and ability, and his experience and knowledge of electric heating was very considerable. During the war he had been carrying out special Government work in connection with electric heating appliances and in other important directions, and his loss will be greatly felt. Mr. Huntley was buried in the Ruislip Parish Churchyard on Saturday last, and was followed by Mr. H. J. Dowsing and Mr. A. C. Newstead, two directors of the company, and a number of his fellow employés. Mr. Huntley was a Freemason, and his Lodge was represented at the funeral.

NEW COMPANIES REGISTERED.

Little Wonder Battery Co., Ltd. (146,385).—Private company. This company was registered on March 9th, with a capital of £7,500 in £1 shares (3,100 10 per cent. cum. pref.), to take over the business of manufacturers of electric dry cell batteries carried on by Albert A. Ball and Co., Ltd., at 8/9, Regnart Buildings, Euston Street, London. The subscribers (each with one pref. share) are: A. Richmond, 4, Budge Row, E.C., manufacturer; J. Price, 71, St. George's Road, Leyton, N.E., secretary. The first directors are to be appointed by the subscribers. Registered office: 4, Budge Row, E.C.

Victoria Chemical Co., Ltd. (146,393).—Private company. This company was registered on March 9th, with a capital of £11,500 in 10,000 ord. shares of £1 each, and 30,000 def. shares of 2s. each, to take over from T. Hadham, F. H. Rogers, and F. B. Dehn the option of purchasing from J. A. Kendall his patent, No. 26,896/12, for the treatment of chlorides of the alkali metals for obtaining useful products therefrom, and the option of purchasing a patent which J. A. Kendall holds jointly with the exors. of the late Sir Joseph Swan for improvements in the manufacture of metallic sodium. The subscribers (each with one ord. share) are: Captain A. G. Elliot, R.F.A., 15, Victoria Square, S.W.; and F. B. Dehn, Broad Sanctuary Chambers, S.W., consulting chemist. The first directors are T. Needham, F. H. Rogers, F. B. Dehn, and A. G. Elliot. Solicitors: J. H. Mote & Son, 11, Gray's Inn Square, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rubber Bronze & Metal Co., Ltd.—Re-issue on February 22nd of £4,400 debentures, part of a series of which particulars have already been filed.

Stephens, Smith & Co., Ltd.—Particulars of £1,200 debentures created February 12th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. Memoranda: Satisfaction in full on February 12th, 1917, (a) of first mortgage debenture dated April 1st, 1903, securing £600, and (b) of second mortgage debentures dated December 3rd, 1903, securing £600, have been filed.

County of Dorset Electric Supply Co., Ltd.—Particulars of £2,500 second debentures created November 27th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £2,000. Property charged: The company's undertaking and property, present and future, including uncalled capital, if any, subject to first debentures for £16,000. No trustees.

Brecknell, Munro & Rogers, Ltd.—Mortgage on lands, factories, &c., at Bristol, dated March 1st, 1917, to secure all moneys due or to become due from company to Lloyd's Bank.

Allen, West & Co., Ltd. (108,870).—Capital, £30,000 in £1 shares. Return dated January 11th, 1917. 25,235 shares taken up; £25,235 paid. Mortgages and charges: £20,000.

CITY NOTES.

Underground Electric Railways Co. of London, Ltd.

Lord George Hamilton presided at the annual meeting. He said that the total receipts of the five companies increased by £557,385, or over 10 per cent. The revenue liabilities, including interest, depreciation, and reserves, increased by £501,783, slightly under 10 per cent. There had been an accelerated rate of increase in working expenses, and there

was every indication that these would become still greater in the current year. The maintenance of the various properties, while sufficient for safe and regular operation, had not been up to the usual high standard owing to scarcity of material and labour. The companies had, therefore, increased their reserves rather than their dividends. The total income of this company showed a decrease of £27,380 for the year. Under the present conditions no considerable schemes of development and improvement could be carried out. Arrangements had now been completed for the through running of the London Electric Railway trains over the L. & N.-W. line to Watford, and the service would be commenced on April 2nd. The greatest obstacle to the increased prosperity of the operating companies was the increased cost of everything that they required. Coal had increased in price to more than double the pre-war figure, and it was still rising. Lot's Road power station used more than 200,000 tons a year, and the increased cost already amounted to £1 per ton. The District Railway recovered its extra costs under the arrangement with the Government, but the other railways were uncontrolled, and must find them from their own resources. The petrol situation was not only somewhat precarious as to the supply, but the price had been considerably increased since January 1st. The Government Order regarding advertising posters would cause a loss of a considerable part of their revenue from that source, which was not far from £100,000. The increased costs would probably compel them to consider a readjustment in rates of fares. In common with all great transport enterprises, they were beginning to feel the pinch of the war, but the foundations of the business and its profits were sound, and the satisfactory way in which they had stood the strain of the past two years gave confidence for the future.

Notting Hill Electric Lighting Co., Ltd.

Sir Wm. Crookes presided, on March 6th, at the annual meeting. He said that the receipts increased by £868, but this increase was more than nullified by the heavy advance in cost of coal and materials. The net result was a profit of £23,306, against £25,270 for 1915. A further £3,000 had been put to depreciation, &c.; it had not been necessary to trench upon that fund during the year. The total amount of the sinking funds for the redemption of the Wood Lane joint debenture stock is now £79,563. The efficiency in electrical distribution shows an improvement of 2 per cent. Units sold increased from 2,436,498 to 2,438,393. The number of new consumers and of additional lamps connected was the lowest in the company's history, and it was impossible to look forward to any improvement until the close of the war. The Government had recently issued a regulation that no new meters must be purchased except for consumers who required current for Government work and for renewals. The reduction in the dividend on the ordinary shares from 5s. to 3s. was entirely due to the war, but it was only temporary. If the price of coal, &c., were kept within reasonable limits they might be able to show a better result this year. The increase of 10 per cent. in the charge to consumers was only in force three months, but they hoped that the Kensington Borough Council would consent to the increase continuing until after the war. At one time during the year their coal stock fell so low that they were within a few days of having to shut down, but on strong representation in the proper quarter they managed to get a further supply. At present they had a stock sufficient for some weeks. Though the reduced profit reduced also the bonus due under the co-partnership scheme to considerably less than in former years, the employés were receiving a bonus on the scale of the previous distribution, as they had worked so loyally and well. The chairman hoped that the blessing of Peace would be restored before the next annual meeting. He anticipated then the demand would be so great that they would soon return to their usual rate of dividend, and probably exceed it.

City of London Electric Lighting Co., Ltd.

The net capital expenditure at December, 1916, was £2,032,020, an increase of £2,188. The profit has again been prejudiced by the enforced reduction of lighting, by the further increased cost of coal, and all other items of production, and by the effects of the Summer Time Act. The total revenue was £332,936; expenses of generation and distribution £103,322; repairs and maintenance £9,747; street lighting expenses £3,217; rent, rates, taxes, management expenses, &c., £82,824. Including £18,024 brought forward, £151,849 is the available revenue. After deducting loan charges, debenture stock charges, employés' provident fund, and putting £40,000 to the reserve, £79,501 remains for dividend. The preference dividend is paid, and 8 per cent. per annum on the ordinary shares (as in the previous year). £17,132 is to be carried forward. The gross revenue increased by £21,117, and the net revenue by £16,980. The average price obtained per unit rose from 2.27d. to 2.51d. The number of customers fell by 104 to 14,616, but the connections increased by 1,170 kw. to 47,331 kw. The reduction in customers is due to war conditions, which have caused the suspension of many businesses, notably among stockbrokers and foreign banks and firms. The units generated were 33,758,872; sold 28,982,456 (a decrease of 496,623); metered and used by the company 1,966,187; expended in distribution, &c., 2,810,229. The maximum supply demanded increased from 17,424 kw. to 19,198 kw. Power and heating units continued to show a steady increase; power took 12,321,795 units, and heating 3,165,613 units = 15,487,408, equal to 54.9 per cent. of the total units sold for private supply. The Marquess of Winchester, a director, is still serving with the Army in France. Leave has been granted to Mr. A. F. Harrison, the secretary, to take up a Commission in the Royal Defence Corps. Nine members of the staff have been killed, 19 wounded or invalided, and one is a prisoner of war. The company applied for £37,400 War Loan, making the total £50,000.

Newcastle-upon-Tyne Electric Supply Co., Ltd.

During 1916 the connections increased by 24,360 h.p. to 282,750 h.p. The profit was £224,266 (against £204,419 last year), plus £5,191 brought forward, less £60,568 interest on debentures, &c. The preference dividend, 5 per cent., absorbs £45,617, 7 per cent. on the ordinary shares requires £55,837 (last year 6 per cent. was paid), there is put to depreciation reserve £30,000, against £25,000, and to general reserve £30,000, against £28,000, £7,435 being carried forward. Out of the £28,000 put to reserve last year, the balance of the cost in connection with the issue of first and second mortgage debenture stocks, amounting to £13,798, has been written off, and £12,593 transferred as a provision for possible loss on realisation of investments. Plant, mains, &c., have been efficiently maintained, £98,199 having been spent thereon out of revenue. Extensions in progress at Carville and Dunston power stations and to the general distribution system during the year cost £63,882. It is proposed to make an offer to acquire, by an exchange of shares, the shares and funded preference income stock of the Cleveland and Durham Electric Power, Ltd. The scheme is to be submitted at the annual meeting on March 23rd. If the proposed exchange of shares is carried through it will involve an increase of this company's capital.

County of London Electric Supply Co., Ltd.

Mr. J. B. Braithwaite, presiding at the annual meeting on Monday, said that the receipts from sale of current had increased by nearly £44,000, and although the cost of coal had gone up by 90 per cent. their coal costs during the year only increased by 65 per cent. as compared with 1914. Whereas in 1914 the freight from the Tyne to London was 3s. per ton, at present it was 18s. Coal had risen from £62,398 to £87,475. The total expenses advanced from £150,398 to £186,171. The net result was that £156,894 was carried to net revenue account against £159,639 last year. For the first time they had been able to debit the whole of the repairs against revenue, instead of against reserve for depreciation. They were increasing the appropriation to depreciation from £40,000 to £45,000, and intended ultimately to raise this to £50,000, which was the figure he had always considered the one to reach before paying an increased dividend. During the war the riverside stations, which in the ordinary course of things were far more economical than stations dependent upon railway supplies, were now more expensive owing to the heavy rise in freights. At the present time rail-borne coal was cheaper than sea-borne coal. Fortunately, however, the company were able to use both, and by means of the interconnection between City Road and Wandsworth they were able to utilise their coal supplies at either end, whichever was the more economical at any given time. After the war freights would no doubt come down with a run, and stations with water facilities would again prove their greater advantage. Having regard to all their difficulties, restricted lighting, the Summer Time Act, &c., the result shown was an exceedingly gratifying one. They could hardly have had a more difficult year than 1916 proved to be, but so far their officers had managed to bring them through successfully. The arrangement entered into for giving a bulk supply to various tramways and lighting undertakings south of the Thames, at Sutton and elsewhere, had been working very satisfactorily during the past year, over one and a half million units having been sold for this purpose, and they had now come to a similar agreement with the South London Electric Supply Co., in which they themselves were very large shareholders. They hoped that that further interconnection would be made by the end of the present year, and were expecting to sell to that company a large amount of current. As opportunity offered they were steadily pursuing the policy of linking-up and concentrating electric supply in a smaller number of big stations rather than in a large number of small stations. With regard to their scheduled site at Barking for a large power house, that was now carefully protected and secured beyond any question, so that whenever the time came to develop there the site was waiting. They had subscribed £50,000 to the 5 per cent. War Loan. As to the current year, he preferred not to prophesy. He was afraid they must anticipate the war continuing throughout this year, and this would probably mean that the high price of coal would continue, with probably increased difficulties in that respect and also restrictions in various other directions. The Summer Time Act would come into force earlier this year than it did in 1916. The second advance of 10 per cent., however, in the price of current which came into effect on April 1st, 1916, would help their receipts in the first quarter of the present year; he did not want to predict what the final result would be for the year. He thought the company should be able to maintain the dividend, with the possibility of an increased appropriation to reserve this year.

British Engine Boiler and Electrical Insurance Co., Ltd. At the annual meeting, held at Manchester, Mr. R. Charles Longridge (chairman) announced that the results of operations during 1916 were most satisfactory, having regard to business conditions. There had been a marked growth in the number of firms insuring their plant against breakdown, with the result that the premium income had increased from £117,112 to £125,851—their largest advance in any single year, with one exception. They had felt the effects of a noticeable increase in the cost of repairs, and in the cost of travelling expenses. The profit earned showed only a small reduction from the previous year. There had been some further depreciation of the company's investments, which the directors had decided to meet by writing off the sum of £7,553 out of profits, and after making provision for this and for a final dividend, the total funds of the company stood at the increased figure of £179,777. Their chief engineer, Mr. Michael Longridge, had been elected President of the Institution of Mechanical Engineers.

Cleveland & Durham Electric Power Co., Ltd.—The capital expenditure during the year was £4,819. Gross profits were £37,130, as compared with £31,157 in 1915. The profits shown are largely due to the fact that the majority of consumers have agreed to pay a temporary advance in price and to new contracts at higher prices. To meet increased demands, the whole of the available generating plant has been run continuously. Less the amount required for debenture interest, there remains a net profit of £16,925, plus £8,575 brought forward. A dividend of 2 per cent. on preference shares absorbs £6,674; there is transferred to depreciation and renewals account £8,000; and there is applied in reduction of expenses of issue of debentures £1,000, carrying forward £9,825. The connections to the system at the end of the year aggregated 81,469 h.p., as compared with 75,840 at the end of 1915, and a further 11,000 h.p. has been arranged for. Regarding the suggested exchange of shares with the Newcastle Supply Co., the directors have prepared a scheme. They are satisfied that the development of the area cannot otherwise be adequately proceeded with.

South London Electric Supply Corporation, Ltd.—The gross receipts during 1916 were £59,037, and the expenses were £30,649, leaving £28,388, plus £3,010 brought forward. There is placed to depreciation £7,000, and after paying debenture interest and 6 per cent. preference dividend, the balance is £16,053, out of which 5 per cent. is paid on the ordinary shares, and £3,053 is carried forward. New connections were 26,481 lamps (927 kw.), making the total 392,999 lamps (equivalent) (13,754 kw.). The units sold were 6,698,357, an increase of 380,217. Units generated 8,372,740; used on works 378,490; expended in distribution 1,295,893. Annual meeting: March 20th.

Bristol Tramways & Carriage Co., Ltd.—The gross receipts for 1916 were £555,907; working and general expenses and renewals, £450,447; including balance brought forward, net revenue £110,516. After paying the debenture charges, preference interest, 6 per cent. (less income-tax) on the ordinary shares, and putting £30,000 to reserve fund for contingencies and renewals, £9,636 is to be carried forward. The receipts of the tramway department increased by £6,241, or 2½ per cent., and those of the carriage department by £35,552, or nearly 14 per cent. Passengers carried on cars and omnibuses were 60,628,342, an increase of 355,942.

Northampton Electric Light & Power Co., Ltd.—The annual meeting was held on Friday, Ald. F. H. Thornton, J.P., presiding. The chairman said that good progress was being made with the new works at Hardingstone. The site was being raised 4½ ft. to avoid the danger of flooding. In connection with that work £36,000 of the £50,000 asked for was subscribed, so that, with a few debentures which would be available, practically the whole of the money was obtained.

Rushden & District Electric Supply Co., Ltd.—The annual meeting was held on Friday. Ald. F. H. Thornton, J.P., said that a new engine had been installed during the year, but almost the whole of the current supplied had been taken up, and the company had been doing work of enormous national importance. The increased cost of coal and oil had compelled them to raise their charges, but that was inevitable, and like action had been taken by other companies.

Companies Struck Off the Register.—The following companies have been struck off the register, and are dissolved:—

Electric Stores, Ltd.
Hammersmith Welding, Engineering & Electrical Co., Ltd.
New Electric Rifle & Target Co., Ltd.
Panama Electric Lighting, Power & Traction Co., Ltd.
Telephone Instalment System Co., Ltd.

Stewarts & Lloyds, Ltd.—After setting aside £100,000 for depreciation and paying 6 per cent. on the preference and 10 per cent. on preferred ordinary shares, a dividend is recommended of 2s. on deferred shares, together with a bonus of 6d. per share. £60,000 is placed to general reserve, £20,000 to employés' benefit reserve, and £110,000 is carried forward. —*Financial Times.*

British Westinghouse Electric & Manufacturing Co., Ltd.—The directors recommend a dividend of 7½ per cent. on the preference shares.

Bournemouth & Poole Electricity Supply Co., Ltd.—The balance from revenue account for 1916, after deducting generating and other costs, rates, taxes, fees, &c., is £35,215, plus £3,607 brought forward. Debenture and loan interest absorbed £8,782, leasehold and special redemption fund and interest £2,047, reserve for depreciation, &c., £8,000, leaving £19,993. After paying the preference dividend and 6 per cent. on the ordinary shares, £2,263 remains to be carried forward. Total applications increased by 910 kw. to 11,459 kw. Units sold for all purposes 4,082,836; used on works 779,990; not accounted for 826,331; units generated 5,689,157.

Brompton & Kensington Electricity Supply Co., Ltd.—The accounts for 1916, subject to audit, and after appropriating £7,150 to depreciation and reserve, admit of a final dividend at the rate of 7 per cent. on the preferred shares and a final distribution at the rate of 10 per cent. on the ordinary shares, making 9 per cent. for the year, less tax, carrying forward £5,075.

Scarborough Electric Supply Co., Ltd.—The lamp connections at December last totalled 132,542 (30-watt), an increase of 765. Units supplied, 618,019. Profit, £715. After paying bank interest and placing £500 to depreciation account, the credit balance is £1,602, which is to be carried forward.

Hadfields, Ltd.—In addition to the interim dividend of 1s. per share, a further dividend of 4s. per ordinary share is announced, making the rate the same as last year, together with a bonus of 1s. per share, all free of tax.

W. T. Henley's Telegraph Works Co., Ltd.—Subject to audit, the directors recommend a final dividend on the ordinary shares of 10 per cent., less income-tax, making 13 per cent. for the year, and also a bonus of 10s. per share, less income-tax, the same as a year ago.

Direct Spanish Telegraph Co., Ltd.—Dividends at the rate of 10 per cent. per annum on the preference shares, less income-tax, and at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares (making 5 per cent. for the year 1916), both for the half-year ended December 31st last. In addition, a bonus on the ordinary shares of 2 per cent. for the year 1916, free of tax.

Western Telegraph Co., Ltd.—Second quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1917, at the rate of 6 per cent. per annum.

STOCKS AND SHARES.

Tuesday Evening.

There is a good deal of strength about the markets round the House. The capture of Bagdad was hailed with a feeling of relief, though this was tempered to some extent by the slight anxiety felt in regard to affairs in Russia, the food problem, for instance, being noted with some nervousness. The news from the Western Front is considered distinctly satisfactory; and, on this account, capital is finding its way readily into gilt-edged markets and those also which offer high rates of interest attached to speculative conditions, such as surround the rubber industry.

It is pleasant to be able to record a spurt in the market for Home Railway stocks, although so far the improvement is mostly confined to what is called the heavy brigade. Pre-eminent amongst these, North-Western stands out as most in favour, it being held that the electrification prospects add to the other attractions of the stock. In regard to the purely Underground group, the meeting of the Underground Electric Railways, held last week, produced dulness for the time being.

Lord George Hamilton's reference to the possibility of fares being raised, while it evoked applause from the stockholders, aroused some comment in the market as to whether such a step might not lead to curtailment of travelling, though it was pointed out, in answer to this objection, that, as the Tubes and 'bus companies are nearly all under one control, the vast body of travellers would have no option but to pay what the companies liked to charge in order that they might get backwards and forwards to and from their work. Underground income bonds fell back to 80½, but Districts gained 10s.; the market in Metropolitan Consolidated stock is stagnant.

Electricity supply shares keep very firm upon the publication of the dividends. Metropolitans are ¼ up. The City of London report is one of the most interesting this week. Gross revenue rose to £333,000, an increase of £22,000, for the corresponding period, but net profits dropped to £105,000, some £23,000 less than those of 1915. As already noticed, the dividend is retained at 8 per cent. The carry-forward of £17,000 is slightly reduced from that of a year ago. The Bournemouth & Poole Co. has declared a final dividend at the rate of 7 per cent., making 6 per cent. for the year, the same as that for the previous twelvemonth.

Marconis are again conspicuous, with a rise to 2¾, the usual reason for the buying being advanced, namely, the expectation of what the company will receive from the Government by way of compensation for its services since the outbreak of war. Nothing has been paid, of course, up to the present. With the rise in the parent shares Americans sympathised by improving to 16s. 3d. Canadians firmed up to 8s. 9d. It is

humorously hoped by some that the Government will defer making any award until after the conclusion of Peace, since it is the uncertainty which stimulates activity in the market, and gives the speculator something to "go for." There are no other changes to report in the telegraph market.

Brazil Tractions have risen to 47, Brazilian issues of all kinds being decidedly firmer. The apprehension aroused by the action of our Government in forbidding exports of foreign grown coffee has to a large extent subsided, and buyers are on the look out for what they regard as cheap stock. Argentine Tramways continue dull, although for other Argentine issues there is more inquiry. The Mexican group is fairly steady, and a rise of a point occurred in Mexico Tramways 5 per cent. bonds, though it must be confessed that what little news has come through from Mexico is not particularly cheering.

The feature of the manufacturing group is a rise of 4½ in Edison Swan 4 per cent. debenture stock. The Fives advanced to the same figure, showing a gain in their case of 3 points. The partly-paid shares are better at 11s. 3d., and it is expected with some confidence that the new scheme will enable the company to advance within sight of dividends on the shares. General Electrics are 10s. up. The prices in this department are firm, with few shares on offer. In fact, industrials as a whole show a good deal of strength. The rubber market is still the centre of attraction for those whose fancy attracts them to speculative investments. Considerable activity prevails throughout the list, and the steady way in which the price of the raw material hugs 3s. 3d. per lb. is conducive to confidence on the part of the buyers. Iron, armament, and steel shares have begun to revive. So far as the markets for base-metal shares are concerned, there is little that is new to report.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Mar. 13, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	8⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	8 5/16	—	7 1 2
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9⅞	—	6 1 6
County of London	7	7	10½	—	6 16 7
do. 6 per cent. Pref.	6	6	9⅜	—	6 6 4
Kensington Ordinary	9	7	5⅜	—	5 11 7
London Electric	4	3	1	—	Nil
do. do. 6 per cent. Pref.	6	6	8⅜	—	5 6 8
Metropolitan	8½	8	2⅜	+ ⅛	6 6 4
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	2⅝	—	6 19 0
South Metropolitan Pref.	7	7	1 3/16	—	6 7 8
Westminster Ordinary	9	7	5⅜	—	6 1 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94	—	6 7 8
do. Def.	80/-	83/6	22	—	6 16
Chile Telephone	8	8	6 5/8	—	5 15 3
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	13⅜	—	*5 16 4
Eastern Tel. Ord.	7	8	137	—	*5 16 10
Globe Tel. and T. Ord.	6	7	11½	—	*5 19 2
do. Pref.	6	6	9⅜	—	6 3 1
Great Northern Tel.	22	22	34⅜	—	6 7 5
Indo-European	13	13	46½	—	5 19 9
Marconi	10	10	2⅛	+ 1/16	3 9 2
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2⅛	—	4 14 1
United R. Plate Tel.	8	8	6⅜	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅜	—	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1½	1	26	—	4 7 0
do. District	Nil	Nil	16½	+½	Nil
Underground Electric Ordinary	Nil	Nil	1¾	—	Nil
do. do. "A"	Nil	Nil	5,6	—	Nil
do. do. Income	6	6	80½	—1½	*6 9 1
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 1/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	2⅝	—	9 11 4
do. 2nd Pref.	5½	5½	1⅜	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	47	+ ½	8 10 2
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfce.	5	5	60	—	8 6 8
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	26	+1	Nil
do. 6 per cent. Bonds	—	Nil	93½	—	Nil
Mexican Light Common	Nil	Nil	7⅞	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	97½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	22	—	5 9 1
British Aluminium Ord.	5	7	27/6	—	5 8 0
British Insulated Ord.	15	17½	12⅜	—	6 17 8
British Westinghouse Pref.	7½	7½	2 1/16	—	6 9 10
Callenders	15	20	12½	—	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	8⅜	—	6 10 8
Edison & Swan, £3 paid	Nil	—	1/16	+ 1/16	Nil
do. do. fully paid	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	66	+4½	6 1 8
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	14½	+ ½	6 18 0
Henley	20	25	15	—	8 6 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	11⅜	—	*8 10 2
Telegraph Con.	20	20	37	—	*6 15 2

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	"	£54	..
a Bisulphide of Carbon	"	£23	
a Borax	"	£38	£4 inc.
a Copper Sulphate	"	£63	..
a Potash, Chlorate	per lb.	2/6	..
a " Perchlorate	"	2/-	
a Shellac	per cwt.	18⅛/-	1⅝/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	"	£32	£4 inc.
a " Lump	"	£26	..
a Soda, Chlorate	per lb.	1/-	..
a " Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/8⅜ to 1/9½	..
g " Bars (best selected)	per ton	£174	..
g " Sheet	"	£174	..
g " Rod	"	£174	..
d " (Electrolytic) Bars	"	£151	..
d " " Sheets	"	£176	..
d " " Wire Rods	"	£159	..
d " " H.C. Wire	per lb.	1/7	..
f Ebonite Rod	"	3/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	2/3	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	3/2	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£38	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	6d. to 3/-	..
e " " " medium	"	3/6 to 6/-	..
e " " " large	"	7/3 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	3/-	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Linking-up Electricity Works.—A meeting of representatives of electricity supply undertakings was held recently at Plymouth, to consider the linking-up of works in Devon and Cornwall. It was decided to go into the matter in detail, and to prepare a suitable scheme. The area was divided up into four districts, respectively adjoining Exeter, Torquay, Plymouth, and Hayle, and the engineers of the electricity works in these localities are to collect information and report progress to Mr. E. S. O'Kell, of Plymouth, who was appointed chairman of the Committee.

At the second meeting of the North-East Coast Committee which has been appointed to investigate the linking-up of power stations, it was decided that load diagrams should be exchanged between the Sunderland and South Shields electrical undertakings and the Newcastle Electric Supply Co., with a view to finding out whether it would be to the mutual advantage of the parties to link up in order to give and take a supply of current. Apart from the cost, it would not be a difficult matter to link up Sunderland and South Shields undertakings, because in each case the periodicity of the alternating-current supply is the same; consequently, all that is required is a connecting cable, or cables, between the two power stations (about 7 miles apart), and the necessary transformers, the voltages being 5,500 and 2,200 volts respectively.

With regard to South Shields linking-up with the Newcastle Electric Supply Co., the conditions are more complicated, in that the frequencies of the two supplies are different—one being 50 cycles and the other 40 cycles per second—so that it would be necessary to install frequency changers.

Conferences of West London authorities are taking place with the idea of establishing on a co-operative basis a bulk supply power station on the banks of the Thames to deal with the whole of the non-peak supplies for the western area of Greater London.

The British Empire Producers' Organisation.—This organisation held another luncheon meeting at the Savoy Hotel, on Wednesday. Viscount Milner presided, and he was supported by Sir Edward Morris, Prime Minister of Newfoundland.

Chemical Manufacturers' Association.—The first general meeting of the Association of British Chemical Manufacturers was held last week. Dr. Charles Carpenter, who presided, said their object was to do for their industry what had been done for engineering in this country and for applied chemistry in Germany.

FIGHTING HAIL AND STORM BY "ELECTRIC NIAGARAS."

(*Concluded from page* 275.)

Installation and Maintenance of "Niagaras."—The electric niagara is simply a large-capacity lightning conductor. Its action in discharging storm clouds is generally in the form of invisible brush-discharge (or aigrettes). During very violent storms (or incipient violent storms) the brush discharge may be visible. This is unimportant if the discharge is *usually* invisible, especially if there be a second line of niagaras in the barrage to complete the protection. On the other hand, if the discharge is regularly visible, the niagara is probably of insufficient capacity, but, before altering it, the resistance of the conductor system itself, and of the earth connection and of the surrounding soil should be measured. The conductor system should be of high conductivity, with ample surface rather than large cross-section, and the path to earth should be as free as possible from bends.

If lightning strikes the niagara, this is a still more definite indication that its capacity is inadequate,* whilst the most serious sign of all is a lightning flash *in the neighbourhood* of a niagara, for this indicates a very defective earth connection, and, so far from the niagara being of any value in such a state, it is rather a source of danger, and may disturb telegraphic operation in the vicinity.

The precise construction and arrangement of niagaras varies with the altitude, the frequency, and nature of storms hitherto noted in the neighbourhood, the presence of high buildings, trees, &c. In all cases, however, high conductivity, large surface of conductor, minimum self-induction, and low-resistance earth connection are essential. The closer together the posts, the more certain the protection afforded, and they should always be on the highest ground, so that storm clouds may not pass over them "untapped." The area protected by each niagara varies with the potential of the storm clouds, with climatic conditions, and with the height, altitude of erection, and general surroundings of the post. As a rough guide, a niagara 100 to 130 ft. in height should protect an area extending 2½ to 3 miles right and left of the station, an equal distance in the direction of the storm wind, and from 550 to 1,100 yd. against the latter.

Provision has been made in France to ensure that the proposed construction and location of niagaras (whether singly or in barrages) shall be approved by a central committee, in order that the best results possible shall be attained, and in order that a consistent and homogeneous system of protective posts may gradually be developed. In laying out a barrage, the centre O of a certain vineyard or other estate

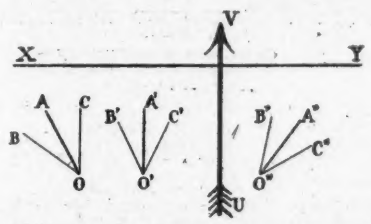


Fig. 1.—Laying Out a Barrage of "Niagaras."

is marked on a map or scale drawing (fig. 1), and the usual direction A O of storm-bearing winds is marked, the necessary information being derived from local experience or from meteorological statistics. Lines B O, C O are then set out representing the limiting directions of storm-bearing winds. Naturally, the line A O does not necessarily bisect the angle B O C, and it may happen that one of the limiting directions is practically opposite to the prevailing direction for the district, owing to storm clouds being sometimes carried along valleys on practically a semi-circular course. The angle B O C represents the sector of storm-winds for the area of which O is the centre. In similar manner, sectors B′ O′ C′ and B″ O″ C″ may be set out for the centres O′, O″ of adjoining areas. The direction U V is the "resultant" of O A, O′ A′, O″ A″ and the line X Y, perpendicular to U V, is a suitable line for a barrage intended to protect the area considered. Posts about 100 ft. to 130 ft. in height (and not less than 30 ft.–35 ft. higher than trees in the neighbourhood) are then set out on or near the barrage line and on high ground, so that they may deal with storm clouds, whatever the direction of the latter and their undulations with regard to those of the ground. Each post of a barrage designed on these principles becomes the focus of a protected area, and the curve enveloping all these areas includes the whole district protected by the barrage. According to circumstances, the barrage is set on a straight or curved line, or on the sides of a rectilinear or other closed figure. The posts may be aligned or staggered.

Results Obtained in France.—There are at present five barrages of niagaras in France, that of the Vienne being the oldest, and followed by those of the Dordogne, Beaujolais, Gironde, and the Lower Loire. The Vienne barrage has six posts, and, during the storms which have broken in Poitiers since this barrage was erected, very little hail has fallen in the protected zone, whereas formerly the banks of the Clain and the Boivre were often swept by hail. The St. Julien niagara and the Chauvigny post have proved very satisfactory, and testimony as to the good effects of the Paizy-le-Sec post is to be found in the petition by the municipality that the niagara should be re-erected after it was thrown down by a cyclone in 1911. The St. Savin-sur-Gartempe niagara is on a basilica steeple 330 ft. in height, and the protection it affords is practically complete. The Chitré post, established in 1912, protects a well-defined parabolic area, the axis of which is the direction of the wind, and the focus the post itself.

On the other hand, the Beaujolais barrage has not given satisfactory results; indeed, £400,000 worth of damage was done in 1913, as against £100,000 average for the years 1901-10, when hail cannon were in use, and £280,000 average for the period 1891-1900, when no protective measures were in force. If this unsatisfactory result be compared with the very favourable official report from the Dordogne and Vienne districts (where exactly similar equipment is in use), it is obvious that the trouble lies not in the system, but in local conditions or faulty application of the system thereto. The rocky nature of the country in the Beaujolais district is very unfavourable to effective earth connection, and the heights of the very broken land have little forest growth upon them. Probably the unsatisfactory nature of the earth-contact and the high resistance of the earth in this district are the cause of the unsatisfactory protection yielded by the niagaras. Hailstones the size of a nut have been known to fall on the Regnie niagara, and, during another storm, the Thion post seemed to attract lightning flashes and to divert storm clouds. M. Chatillon has emphasised the importance, when laying out a barrage, of providing not only for the prevailing storms, but also for "return storms" from (or nearly from) the opposite point of the compass. Under the influence of low winds (near the ground) developed and guided by valleys, gorges, &c., storm clouds may be temporarily divided, and subsequently brought into collision with one another to the accompaniment of a deadly hailfall. The Saône Valley, for instance which bounds the Beaujolais district on the east, runs S.E. to N.E. from Lyons to Villefranche, and does much to deflect storms coming from the south-west or west.

In 1911 two niagaras were installed on the Eiffel Tower for experimental purposes. Each of the supports of the top terrace of the Tower carries a band of electrolytic copper terminating in four points in the form of an inverted Y, constituting the "diffusing" system. Four strips of copper run from the diffuser down the whole height of the tower (984 ft.), and are connected to the pipes serving the hydraulic lift and to 33-ft. wells sunk specially for the purpose. Neither hail nor lightning was observed near the Tower in 1912, hence plans were completed for the erection of two more hail-rods in the Paris district, one on the Pantheon, the other on the Montmartre basilica.

Following the completion of maps showing the direction, intensity, and frequency of storms all over France, it is hoped to erect a system of barrages which will protect the whole country. The principal frontier barrage will run from the Spanish frontier to Bidassoa, about half-way along the Pyrenees (to meet a barrage running alone the Gironde), and also along the whole coast line to Cherbourg. This barrage will afford frontier protection against storms from the south-west, and use will be made of lighthouses, semaphores, wireless masts, spires, &c., as supports for the hail rods wherever practicable. It is hoped that all the low-lying (most dangerous) clouds entering France from the south-west will be thus discharged. Inland barrages will, however, be necessary to cover the possibility of clouds being dangerously electrified by one means or another after entering the country. The inland barrages will be across the general direction of prevailing storms, and those contemplated run along the Gironde, the Charente, the lower reaches of the Loire, the Rhone, and upper reaches of the Loire, from Orleans to Evreux, from Avranches to Nantes across Brittany, from Bourges to Poitiers, and on to the coast, round the whole Mediterranean coast from Spain to Italy, and from Belfort to the Belgian frontier. The total cost of all these barrages would be small in comparison with the losses which are now occasioned every year by hail and lightning; moreover, by manufacturing the component parts on a large scale the cost per unit would be reduced materially.

M. Turpain has suggested the use of lofty trees on high ground as supports for niagaras, and, in order to give the conductors the desirable surface, they might be composed of two copper wires carrying between them a strip of thin brass sheet 12 in. to 16 in. in width. It is absolutely essential, in all cases, to obtain an earth connection of negligible resistance, and, if possible, in a direct continuation of the foot of the conductor. Running water makes the best earth connection, but if this be not available, connection may be made to permanently moist subsoil or to an "artificial" earth made by the aid of coke. Wells often act as huge Leyden jars, and isolated layers of moist soil surrounded by rock or other poorly conducting media, are often very unsatisfactory as earth connections. Hail rods built on this principle could be erected every 500 yd. or so, according to the frequency and

* The St. Julien niagara, which has been very effective, has been known to be struck only once during 17 years, and it very rarely shows visible brush discharge.

intensity of storms; more lofty rods of specially large capacity would be desirable at intervals.

It is not only in France, but in many other countries as well, that interest is being taken in electric "niagaras." From the Himalayas to the Andes, and from Russia to the Transvaal the possibilities of barrages are under consideration. In Argentina, for instance, a niagara 180 ft. in height was recently installed in the province of Mendosa at the foot of the Andes, and four other posts are under erection. Ultimately, it is hoped, useful application will be found for the vast quantities of electricity collected by barrages of niagaras, so that the latter may benefit crops by electroculture, by electrically-manufactured manures, and by electrically-driven agricultural machines, as well as by protecting them from the ravages of hail and lightning. For this optimistic view of the future, however, we accept no responsibility.

THE VOLTAGE REGULATION OF ROTARY CONVERTERS.

By G. A. JUHLIN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The importance of the rotary converter as a link in power distribution is constantly increasing, as well as the necessity of utilising to the utmost the material at our disposal. In order to obtain the best possible results at minimum expense, it is essential that the exact conditions of operation as regards voltage regulation and power factor should be known, and that the influence of the one upon the other should be clearly understood.

It is of great advantage to keep the range of voltage within the smallest possible limits compatible with the requirements of the service for which the machine is intended, as the difficulties and cost may be increased to a great extent by a few per cent. extra regulation, which may bring the range outside the limit of one system and, therefore, necessitate the adoption of a more costly arrangement.

Reactance Control.—If reactance is introduced in the line or in the transformer supplying a rotary converter, and wattless currents are produced which flow through this reactance, the E.M.F. delivered to the converter slip-rings can be increased or decreased, depending on change in the field strength of the machine. This will be clear when it is considered that a leading current is 90 deg. ahead of the load current, and therefore 90 deg. ahead of the E.M.F. in phase with this current. The E.M.F. of self-induction produced by this wattless current lags 90 deg. behind it, and is, therefore, in phase with the E.M.F. supplied to the converter, thus increasing it.

A lagging current is 90 deg. behind the E.M.F. in phase with the load current, and as the E.M.F. of self-induction lags 90 deg. behind the current producing it, it will lag 180 deg.

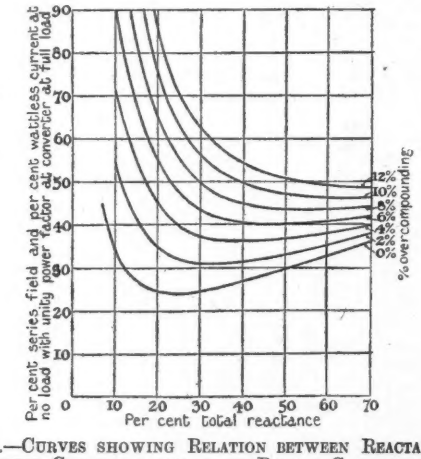


Fig. 1.—Curves showing Relation between Reactance and Wattless Current required in Rotary Converters for Different Amounts of Over-compounding.

Resistance = 3 per cent.

behind the supplied E.M.F., consequently decreasing it. Thus, if a reactance is introduced, the E.M.F. at the continuous-current terminals can be increased by strengthening the rotary field, and reduced by weakening the field.

The wattless currents may be produced by variation in the shunt current, in which case the voltage variation is independent of the load, or, if the voltage regulation be desired as a function of the load, the wattless currents may be produced by a series winding.

In order to determine the most satisfactory value of reactance for a given compounding, it is necessary to know the change in wattless current with varying values of reactance.

The E.M.F. of the high-tension side of the transformer is assumed to be constant, and as the E.M.F. desired is fixed at no load and full load, an expression for the transformer electromotive force is easily obtained assuming the power factor at the converter to be unity at full load, from which the value of the wattless current is obtained. Fig. 1 shows the approximate relation between wattless current and reactance for different values of compounding. The curves are approximate in so far that the influence of saturation in the converter has not been taken into account. It would obviously not be possible to make allowance for this, owing to the very wide range over which it varies in different designs. The influence of the saturation on the compounding will, however, be discussed later. The curves are based on the assumption that the E.M.F. of self-induction of the transformer varies in direct proportion to the current. A total resistance drop of 3 per cent., including transformer and converter, has been assumed. This value will, of course, vary with the capacity and voltage of the machine under consideration, but may be taken as an average for ordinary outputs and voltages. The ohmic, as well as the reactance, E.M.F.'s are expressed as a percentage of the no-load E.M.F., and the power factor has been taken as unity at full load. The curves may, however, be used without any appreciable error in cases where unity power factor is desired at any other load. In such a case the value obtained from the curves does not represent the wattless current at no load, but what may be termed the change in wattless current between no load and full load. For example, 10 per cent. compounding with a reactance at 25 per cent. gives 63 per cent. wattless current at no load with unity power factor at full load. If, instead, it should be desired to obtain unity power factor at half load, the wattless current would be approximately half of this value, lagging at no load and leading at full load. The amount of series field required would therefore be approximately the same in either case.

It will be seen that, except in cases of high percentage of compounding, the reduction obtained with increased reactance is very small when the reactance is higher than 30 per cent. Higher values than this are seldom met with in practice, as transformer builders are unwilling to build transformers having very high reactance, and the extra cost entailed in providing separate reactance is not compensated for by the small reduction obtained in the wattless current.

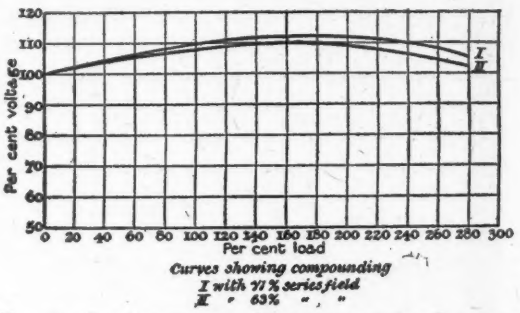


Fig. 2.—Compounding by means of Reactance having Straight-line Characteristic.

Reactance = 25 per cent. Resistance = 3 per cent.

The question as to the point of the load at which unity power factor at the converter should be obtained is of considerable importance. Large lagging currents can be carried by the converter at no load without difficulty, and, so far as the system is concerned, a lagging power factor is less objectionable at light loads than at heavy loads. If the lagging currents are large at no load, the leading currents required at full load or overload are reduced, which is advantageous for the converter as regards losses in the armature as well as the field copper.

For railway service it is usual to adjust the field so that unity power factor is obtained at three-quarter to full load. In general, it may be said that it should be at a point somewhat above average load, and, in making the choice, due consideration should be given to the extent and duration of overloads.

Low reactance and large wattless currents give, in cases where the saturation of the converter is low, better compounding on overloads than high reactance and small wattless currents, but in machines where the saturation is high the reverse may be the case.

The influence of saturation and leakage may be seen in fig. 2, which shows the voltage curves of a converter arranged for 16 per cent. over-compounding from no load to full load. The total resistance drop of converter and transformer is taken to be 3 per cent., and the reactance 25 per cent., including that of the converter armature. The power factor at the converter has been assumed to be unity at full load.

The lagging current required at no load would be 63 per cent. of the full-load current, and consequently the ampere-turns of the series field should be 63 per cent. of the effective armature ampere-turns at full load, neglecting saturation in the converter. Owing to the saturation, however, the field

strength required at the full-load voltage is greater than that actually obtained, as the shunt current is only increased in direct proportion to the voltage, and the difference must therefore be compensated for by means of lagging currents from the line. This would mean that the power factor would not be unity at full load, nor would the required voltage be obtained. It is therefore necessary to increase the ampere-turns of the series field, in order to compensate for the difference in shunt excitation required at full load and that actually obtained at this load. In cases of high saturation, this difference may be considerable, and would, as already pointed out, cause a diminution of the compounding. In the case under consideration, the increase in the series field amounted to 8 per cent., so that 71 per cent. instead of 63 per cent. would be necessary.

Another point which is of importance in machines with high saturation is that the leakage is increased when large leading currents are produced. This means that an increase in field current is required in order to produce the necessary flux; but, as no change is made in the field current, the result is a reduction in the amount of leading current produced by the series field, and consequently in the compounding. The difference in compounding obtained with and without allowance for saturation is shown by curves I and II, fig. 2.

The use of reactive iron in transformers, which is employed when a large amount of reactance is desired, has considerable influence on the amount of wattless current and series field required in order to obtain a given compounding, if the reactive iron is saturated, as in this case the E.M.F. of self-induction is not proportional to the current.

In order to show clearly the effect of saturated reactive iron upon the amount of series field required, and on the compounding, a transformer has been chosen in which the reactive iron is practically saturated at full load (saturation assumed to be reached at 22,000 C.G.S. lines): the reactance is 25 per cent. at this point, but is 15.5 per cent. at quarter load. The compounding curve is shown in fig. 3.

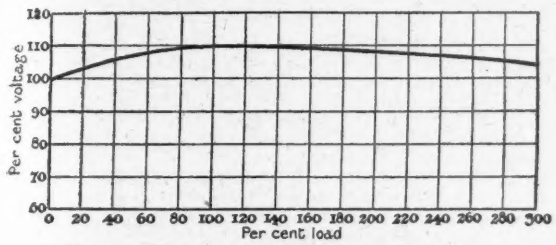


Fig. 3.—Compounding by Means of Reactance.
Reactive iron saturated at about full load.
Reactance at full load = 25 per cent. Resistance = 3 per cent.

The requirements as regards compounding are the same as in the previous case, and the transformer E.M.F. required is therefore also the same. The series field necessary to obtain the compounding is, however, much smaller, due to the high reactance at low currents; it amounts to 33 per cent., including the necessary allowance for saturation, as against 71 per cent. with the straight-line reactance. The wattless currents at different loads are shown in fig. 4, from which it will be seen that with saturated reactive iron at no load only 40 per cent., and at twice full load 45 per cent., of the value required with straight-line reactance are necessary. It will be noted from fig. 3, however, that although the same percentage compounding is obtained at full load, the shape of the compounding curve is not as good. At light loads the voltage rises very rapidly and reaches a maximum at about full load.

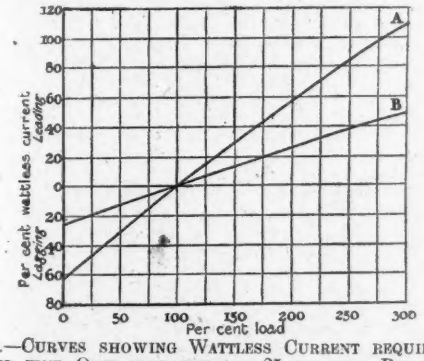


Fig. 4.—Curves showing Wattless Current required for 10 per cent. Over-compounding; 25 per cent. Reactance.
A. With straight-line reactance and 71 per cent. series field.
B. With reactive iron saturated at about full load, and 33 per cent. series field.

Comparing this with curve I, fig. 2, it will be seen that in this case the voltage reaches a maximum at about 100 per cent. overload, so that the regulation in this case is somewhat better. The difference is not great, and, in cases where the design of the converter permits the use of saturated reactive iron, the advantage would seem to warrant its adoption.

The difference in the shape of the compounding curve requires some consideration, owing to the unequal voltages obtained at different loads, as in extreme cases this may lead to difficulties as regards division of load between machines provided with transformers having different types of reactance.

In the case of voltage regulation being obtained by shunt control, the following conditions have been assumed:—

Voltage regulation, 15 per cent., *i.e.*, ± 7.5 per cent. on either side of the mean.

Total reactance, 25 per cent.

Total resistance drop, 3 per cent.

The mean voltage required on the converter has been taken as the basis for the reactance and resistance, which are, therefore, expressed as a percentage of this voltage.

The amount of reactance must, as in the case of compounding, be determined by considerations of design of the converter, and also by the conditions desired for the supply circuit.

With any voltage variation, the value of the wattless current required with a given reactance depends on the conditions as to power factor desired on the high-tension side of the transformer. In the absence of any definite specification in this respect, the conditions most favourable to the converter are equal leading and lagging currents at the extreme voltages, as this will give minimum heating of the armature winding, which is a most desirable condition. This condition should be obtained at the maximum continuous load of the converter.

From the point of view of field heating, large leading currents are undesirable, but as it is generally possible to provide room for the field copper, this is not a limiting feature in design. In the case under consideration, the wattless current has been proportioned for minimum armature copper losses at full load. Under these conditions the wattless current required at the high voltage will increase with the load, whereas at the low voltage the wattless current is a maximum at no load. The wattless currents required at different loads for the maximum and minimum voltages are shown in fig. 5.

In the case of compounding it was seen that the wattless current and the series field required were reduced by the use of saturated reactive iron. With shunt control the wattless current required is practically the same from about full load and over, with straight-line reactance, as with saturated reactive iron.

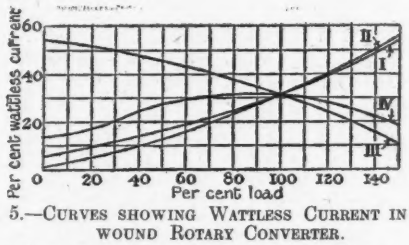


Fig. 5.—Curves showing Wattless Current in Shunt-wound Rotary Converter.
I. Leading current with straight-line reactance.
II. Leading current with reactive iron saturated at about full load.
III. Lagging current with straight-line reactance.
IV. Lagging current with reactive iron saturated.
Regulation ± 7.5 per cent. Reactance = 25 per cent. Resistance = 3 per cent.

There is no advantage, as far as the converter is concerned, in using saturated reactive iron when the voltage variation is obtained by shunt control.

The question of power factor obtainable on converters where voltage variation is obtained by reactance control, is of considerable importance from the point of view of both the designer and the operating engineer. Power factor correction cannot be obtained at will by a converter operating under these conditions, as it is a fixed quantity for a given voltage and load depending on the amount of regulation required, as well as on the point at which unity power factor is desired. The power factor at the converter for a given load is fixed by the amount of wattless current, leading or lagging, necessary to obtain the specified regulation. The power factor on the high-tension side differs, of course, materially from that of the converter itself, as the voltage on the primary side is displaced from that of the secondary side through the introduction of the reactance. Furthermore, the magnetising current of the transformer affects the amount of wattless current on the high-tension side, increasing the current when lagging, but decreasing or increasing it when leading, depending on the relative value of the wattless current in the converter and the magnetising current.

For the case under consideration, the power factor of the rotary converter and on the high-tension side of the transformer would be as follows:—

Voltage	107·5 %	100 %	92·5 %
Power factor at converter	0·96	1·0	0·96
Power factor on H.T. side	1·0	0·96 (lagging)	0·84 (lagging)

In arriving at these figures the magnetising current has been taken as 5 per cent.

By careful consideration of the requirements as to voltage variation and power factor obtainable, it is possible to apply reactance control up to fairly large variations in voltage without serious interference with the power factor.

In cases where two distinct ranges of voltage are required, a combination of reactance control and tappings on the transformer is capable of wide application, and deserves more consideration than it has received up to the present. In many cases pressures of 400 to 440 volts are required for lighting and 500 to 550 volts for traction. The following table shows the power factor at the converter and on the high-tension side of the transformer which can be obtained without excessive wattless currents. These currents are also given in the table:—

	Max. volts 440.	Mean volts 420.	Min. volts 400.
Wattless current ...	47% (leading)	26% (leading)	6% (leading)
Full-load power factor at converter	0·9 ,,	0·967 ,,	0·998 ,,
Power factor on H.T. side	0·99 ,,	0·998 (lagging)	0·97 (lagging)
No-load wattless current	22% ,,	0 ,,	19 % ,,

For the 500- to 550-volt range, the wattless current can be kept within the same values as the above, and the power factor would therefore be approximately the same.

By increasing the leading current at the maximum voltage, it would, of course, be possible to obtain unity or even a leading power factor at the lower voltage, which may be of advantage in special cases.

The range of voltage variation obtainable with reactance control is limited on account of the excessive wattless currents required, and the low power factor resulting therefrom. It is hardly possible to fix any definite limit, as it depends largely on the power factor permissible on the high-tension side.

The wattless currents necessary to obtain ± 7½ per cent. voltage variation, with 25 per cent. reactance may be obtained from fig. 5. These values were based on the conditions of minimum heating in the converter, and the power factor on the high-tension side of the transformer would for this reason be somewhat low. The figures are as follows:—

	Max. volts.	Mean volts.	Min. volts.
Full load—			
Wattless current ...	31%	0	31%
Power factor at converter	0·955 (leading)	1·0	0·955 (lagging)
Power factor on H.T. side	1·0	0·963 (lagging)	0·84 ,,

Considerably better power factors can be obtained by increasing the wattless current, which may be done without causing any difficulties. How far the current can be increased depends on the particular design under consideration, but it is safe to assume that 50 to 60 per cent. wattless current

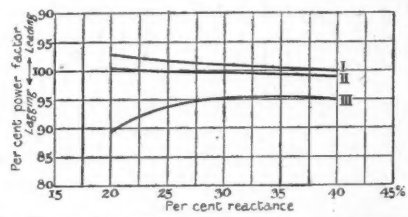


Fig. 6.—Power Factors obtainable on the High-Tension Side of the Transformer of a Rotary Converter.
Voltage regulation of ± 7.5 per cent. obtained by shunt control.
I. Maximum voltage. II. Mean voltage. III. Minimum voltage.

can be carried. Fixing the limit at 55 per cent., and assuming as before a reactance of 25 per cent., the following table gives the results as regards wattless current and power factor at the different voltages:—

	Max. volts.	Mean volts.	Min. volts.
Full load—			
Wattless current ...	55% (leading)	24% (leading)	6% (lagging)
Power factor at converter	0·875 ,,	0·97 ,,	0·998 ,,
Power factor on H.T. side...	0·98 ,,	0·997 ,,	0·935 ,,
No load—			
Wattless current ...	28% ,,	3% (lagging)	31% ,,

These power factors are sufficiently high to be permissible on most systems, and indicate that the regulation considered is within the limits for practical working.

The change in power factor with varying reactance is shown in fig. 6, and it is interesting to note that no improvement is obtained by increasing the reactance above 30 per cent.

In general, it may be said that the limit of voltage variation, for which reactance control is applicable, is about ± 7½ per cent., but it should be noted that if the question of power factor is not of great importance, greater range than this can be obtained with a wattless current of 55 per cent. at full load.

A point of considerable importance in this connection is that it is possible to provide for a greater range in cases where the extreme limits are required for a short time only, as in the case of paralleling, due to the fact that larger wattless currents may be carried for short periods than would be the case for continuous operation. In such cases it may be of advantage to consider the reactance control for ranges which would otherwise be considered outside the limits as regards power factor and wattless current on the converter.

(To be continued.)

Discussion.

Mr. A. M. Taylor, in opening the discussion, said the author evidently wanted to show the advantages of reactance control over booster control for rotary converters. He (the speaker) felt that exception must be taken to the reactance-control type for certain purposes—for instance, in a sub-station at the distant end of the system, where both voltage and power factor might be low, it would be an advantage if some means of boosting were provided there. He was interested in the battery sub-station, and felt that what was wanted was to be able to run a rotary inverted to give a feed into the system coupled with high power factor; this would be really useful, especially if battery plant were involved. It would be useful to have an arrangement such that they could draw a large leading current both on charge and discharge from the line.

Mr. Brazil said where the regulation was 3 or 4 per cent. of the total, reactance control was much the best thing. He had made use of a method of reactance control in conjunction with a direct-current booster driven from the converter shaft, and considered that for battery charging this arrangement was much more effective, but it could be used for other purposes. The effect on power factor of a D.C. booster was the same as in the case of an A.C. booster, and it gave sparkless commutation over a wide range of load.

Mr. R. A. Chattock asked if the reactance machine would not give a leading power factor, if over-excited and with transformer tappings suitably arranged. He thought they might have to revert to the reactance type owing to its simplicity.

Mr. W. B. Woodhouse said the conditions of working referred to by Mr. A. M. Taylor were the practical ones, and he was afraid they would have to retain the booster-controlled machine if they wanted to correct power factor as well as voltage. As regarded comparative costs, he asked what the author's estimate was for a booster with a very small range of voltage and a change-over switch for changing from high to low-voltage ranges.

Mr. H. Burge said it appeared undesirable to depart from the simple converter, with its good commutating features, and it might be practicable to adopt an independently driven booster arrangement.

Dr. R. Smith thought it was agreed that booster control had been overdone in the past; difficulties of commutation prevented the designer from using the materials to the best advantage, unless refinements were introduced. As regards reactance control, he could not see how they could design a transformer to give a straight-line reactance up to 300 per cent. overload, as appeared to be suggested by the author; it must be an abnormal design. It was not only booster-control which introduced difficulties in commutation; it was only fair to state the disadvantages of reactance control, if they were going to use saturated iron, as trouble was likely to occur through sparking in that case.

Mr. Whittaker said the booster-control arrangement was perfectly satisfactory if a liberal design was adopted, but to-day reactance machines could be built to run at a speed which was out of the question for the booster type. In any case, the induction regulator type of machine was more efficient than the booster type, and to-day such machines were designed as self-contained equipments, and to meet conditions which other types could not meet.

Mr. A. M. Taylor interposed to say that he did not think the D.C. booster arrangement would influence power factor adjustment.

The Author, in replying, said the inverted rotary was rather a difficult proposition as regarded power factor correction; clearly, one could obtain a leading current from an inverted machine, as it was then acting as a generator, but it was hard to expect the rotary to do everything. The booster-controlled rotary operated very satisfactorily, but it was not possible to utilise the material to such advantage as in the reactance type. The direct-current booster gave identical conditions with the A.C. booster, and the latter had no influence on power factor. He agreed with Mr. Chattock's remarks, but it was a rather cumbersome thing to change transformer tappings. He thought the arrangement referred to by Mr. Woodhouse would save probably 6 or 7 per cent. in cost. The separately driven booster meant another motor, though it did away with interference with commutation. In regard to Dr. Smith's remarks, the paper referred to 300 per cent. load, or 200 per cent. overload, and straight-line reactance could be obtained in practice for such loads. He believed it was correct to say that reactance was used and that saturation was controlled to meet the requirements. He quite agreed that the induction regulator-control was not fully appreciated, but suggested that it would be even more profitable to investigate the booster-transformer type of control. The induction regulator controlled machine cost more than the transformer type, and the latter was considerably more efficient on high loads.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Re "Alternating-Current Work."

In the very kind review of the above book of mine in your issue of 9th inst., there are two or three points on which I hope you will allow me to comment.

Your reviewer says: "Following the recent suggestions of Dr. Drysdale, a number of remarkably sound mechanical and hydraulic analogies have been given." As a matter of fact, Dr. Drysdale is only cited as a supporter of the use of such analogies. Those (of a mechanical nature) in the book are extensions of some introduced by Prof. George Forbes, F.R.S., at the Royal Institution in 1895, and they are much simpler than, and quite different from, those usually met with.

In criticising what I say about "the indispensable commercial engineer," your reviewer changes "commercial" into "electrical," and remarks: "We are disposed to doubt the indispensability of any electrical engineer to-day who does not possess any special knowledge of either theory or practice. The existence of such gentlemen is beyond dispute, but their desirability is open to question." By "commercial engineer" I mean, of course, the man whose work is chiefly on the business side, and I quote the following from Mr. C. P. Sparks's presidential address in December, 1915:—"I believe that the commercial engineer is just as much a recognised member of our profession as a pure scientist." It is one thing to design a turbo-alternator or a tumbler switch, and quite another to sell it. The designer and the selling man are near the opposite ends of quite a long chain of other indispensable individuals.

Lastly, as there are numerous gentlemen to whom the names "Mr. Hughes" and "Mr. Bishop" might be taken to apply, I would like to particularise those who assisted me as Mr. Edward Hughes, B.Sc. Eng. (Lond.), A.M.I.E.E., of the Heriot-Watt College, Edinburgh, and Mr. Harold Bishop, Graduate I.E.E. Whatever technical merits the book possesses, they are as much due to Mr. Hughes as to myself.

W. Perren Maycock.

London, S.E., *March 10th*, 1917.

Electric Radiators.

It seems to me that your contributor, "Experiment," misses a highly important point in his article on this subject in your issue of last week.

Your contributor is handicapped in discussing the question of ideal electric heater design, because this question cannot finally be decided until we are first clear in our minds, and all agreed, as to the most practically effective temperature to which the radiating body should be raised.

In his opening paragraph, he suggests that "real red heat" is the desirable point on the temperature scale, but later on he talks of a fireclay bar in a certain type of radiator as being a very effective source of radiation, and certainly this fireclay bar cannot be red hot.

Your contributor advocates the use of large masses of fireclay, but I would ask him to calculate the heat units that would be absorbed by these masses of fireclay in attaining the temperature at which they would commence to radiate what he terms "useful heat," and I presume by this that he means "useful quality of heat," as distinct from quantity of heat.

Of course, all electric radiators are of 100 per cent. efficiency in their output of *heat units*, but the man in the street knows nothing whatever about heat units, and only considers the *quality* of the heat, and insists on that quality (temperature) which most nearly represents the comforting glow of the coal fire, as this produces what Mr. Wordingham has termed the correct "physiological effect."

Is it not better to bow to the demands of the man in the street than yield to the dictates of pre-conceived ideas and text-book acquired doctrines so often propounded by mere engineers and architects?

When we talk about the efficiency of an electric heater, we can only do so with reference to the purpose for which the particular apparatus was designed. A low temperature heater may have an efficiency in the neighbourhood of 100 per cent. for boiling water, but the same low temperature heating element would have no efficiency at all for making toast. This is such an obvious truth that it very seldom receives the consideration it deserves, and it has become the custom to talk in an exceedingly loose and incoherent way about the efficiency of electric heating apparatus. It also leads to great confusion of ideas that quantity of heat and temperature should be so often indiscriminately referred to as "heat."

C. Orme Bastian.

London, W., *March 9th*, 1917.

In reference to the article on radiators by "Experiment" in the issue of March 2nd, I should like to take the opportunity of acclaiming *ore rotundo* accord in support of its disclosures, for, in competition with our energetic friends the gas companies, nothing, in my opinion, should be left till absolute maximum efficiency is obtained.

The fact that heating by electricity will become general in the future is certain, but I think its certainty would be more swiftly assured if the manufacturers turned their attention more to heat output than fancy design.

When it is considered that a radiator costs so much per hour definitely, one sometimes feels ashamed of some of the devices designed to produce heat, and the writer has up to the present only found one particular make that can truly be said to give satisfaction, which is the one "Experiment" describes; it will burn trousers, skirts, coats, and furniture, in fact, everything that a coke fire would do if not placed in its proper position in a room.

Further, a real difficulty to intending clients is that they have to rely chiefly on the advice of their particular contractor, but facilities should be available for them to view various makes. This idea may be criticised, but in the interest of the electricity supply industry and a contented client it is, in my opinion, essential.

There seems, however, to be a difficulty with the supply authorities (chiefly municipal) in deciding upon opening a showroom; perhaps local opposition has a word here, or managers are loath to venture for fear of a dead loss (if the sales are not good) to the undertaking, but I would suggest that electricity supply committees or managers could approach manufacturers to meet the showroom expenditure in the various districts, relying on sales and a working arrangement for the good of all parties.

I feel sure that the time is fast arriving when it will be to the interest of the electrical industry to supply a standard piece of apparatus to all who apply.

Mains Engineer.

March 8th, 1917.

The Inspection of Munitions.

It is very gratifying to find "Commercial" adopting a saner and more reasonable attitude towards the question of inspection of munitions. He suggests that in his wisdom he has refrained from saying all he knows about the defects and deficiencies of the officers and inspectors engaged in this work, but why not have shown a little more wisdom, and refrain altogether? Most men who have had a fair amount of experience have acquired wisdom, and a few have even learnt how to ignore trivial matters, and to devote their energies to remedying the more serious ones.

I am prepared to believe that at heart "Commercial" would like to assist the authorities in the production of munitions, and in doing this he is quite safe in exposing any serious deficiency he may find in the personnel of the different departments. But his proper course would be to make his complaints to the heads of the departments, who, as he is probably aware, have requested the manufacturers to notify them of any lack of energy, ability, or tact on the part of the inspectors. In this way he would be acting patriotically, and at the same time doing useful service to the general body of skilled men who are acting as inspectors as a matter of duty, and at a considerable sacrifice. Such exposure of flagrant cases of incompetence would be welcomed, and it would be much more effective in weeding out any incompetent ones than by mere pin-pricking in the Press.

As regards the list of questions which are put forward for my deliberation, while I consider them most superficial and futile in their purpose, I will not undertake to reply to them in the way "Commercial" dictates. At the same time, I ask "Commercial" to take a wider and loftier view of the subject. Inspectors and manufacturers are alike in their fallibility, and, as is usual with purchaser and seller, are apt to look on opposite sides of the question. Lack of appreciation of each other's view leads to misunderstandings, and misunderstanding leads to biased minds. When both sides take up such an attitude it opens out the possibility of unpleasantness, and this, again, reflects on the work which is being turned out.

My advice to "Commercial" is to keep a keen eye on all inspectors, and if he finds one incompetent in his duties to inform the chief of the department of such failing. I can assure him that if his complaint is justified he will have the satisfaction of seeing the culprit relieved of his post. This would be a much more honourable course to take than to brand them all—officers and inspectors—as a lot of ignorant fools.

Albion.

THE RÖNTGEN SOCIETY.

At the meeting of the Röntgen Society on March 5th, Mr. T. Thorne Baker, A.M.I.E.E., read a paper on the use of the X-ray intensifying screen. He said that before many months were past, the sensitiveness of these accelerators was likely to be increased by 200 or 300 per cent. Methods had also been evolved whereby the size of the crystals could be controlled, with the result that the grain of the intensifying screen was practically no larger than that of the photographic

plate with which it was used in contact. It was advisable to have the screen above the plate, sensitive side downwards, and not *vice versa*, as some recommended. He would not say definitely whether a special X-ray plate or an ordinary plate was the better for screen work. This depended upon circumstances. A fact which needed to be taken into account was that the grain of ordinary plates was apt to be much coarser than that of good X-ray plates; the silver bromide in the X-ray plate was precipitated in an exceedingly fine form.

At the same meeting further discussion took place on the subject of sources of ultra-violet radiation in relation to treatment by ultra-violet rays. Major W. J. Turrell said that spectroscopic results showed that tungsten, provided it burned steadily and evenly, was the right metal to use for ultra-violet radiation. The therapeutic value of tungsten radiation consisted first in its destructive action on micro-organisms, and, in the next place, upon the erythema which it produced and which resulted in an increased blood supply and nutrition of the tissues. Since a recent meeting of the Society when this subject was discussed, he had been experimenting with tungsten powder and with pure tungsten for electrodes. The difficulty of using powder in rods was that of getting sufficient compactness. The 98 per cent. tungsten burned away very quickly compared with the pure tungsten. In his hands a 7 in. rod of pure tungsten, costing between 18s. and 20s., burned for 758 minutes, and this was a very good result; on the other hand, a rod of 98 per cent. tungsten burned only for 221 minutes, or one-third of the time. In terms of ampere-minutes, the numbers were respectively 4,489 and 1,254; accordingly, he thought it worth while, in spite of the additional expense, to go on using this pure tungsten unless some better method of preparing the 98 per cent. pure was forthcoming.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—A Decree, dated December 21st, of the Swiss Federal Assembly amends Article 14 of the Federal Customs Tariff Law of October 10th, 1902, and provides that a statistical tax at the following rate is to be levied on all goods passing over the Swiss Customs frontier:—

For goods dutiable (declared) by weight, 2 cents. per 100 kg.
For goods dutiable (declared) by unit, 2 cents. per unit.

The tax is to be not less than 5 centimes for each consignment or each postal parcel.

The Decree is to come into force on a date to be fixed by the Federal Council, and its effect will be that the following classes of goods, which have hitherto been exempted from payment of the statistical tax, will then become subject thereto, viz.:—

"Goods subject to the payment of Customs duty.
"Goods imported or exported in the course of frontier traffic.
"Goods imported or exported in local market trade.
"Consignments of goods sent through the post."

TERRITORY KNOWN AS "GERMAN EAST AFRICA."—Regulations in regard to trading facilities in the occupied territories of "German East Africa" are published in a recent issue of the East Africa Protectorate *Gazette*. The ports of Pangani, Sadani, and Bagamoyo are declared to be open for coastwise traffic only, no direct foreign trade being allowed. This traffic will be controlled from Tanga and Dar-es-Salaam, and direct coasting trade between the three ports is not allowed, unless specially authorised by the Customs Authorities at Tanga and Dar-es-Salaam. Coasting traffic is at present limited to these three ports. [All goods entering the port of Tanga have to pay an import duty of 10 per cent. *ad valorem*—see the Review of December 22nd.]

BERMUDA.—A Government notice, dated December 15th, prescribes a new method for ascertaining the value of goods subject on importation to *ad valorem* duties. Such value is now to be ascertained by the declaration of the importer, or his agent, made or subscribed before the proper officer of the Revenue Department, and shall include the invoice cost of the goods, the cost of all barrels, cases, crates, boxes, sacks, and other external packages and coverings of every kind, and all other costs, charges, and expenses incurred in placing such goods in condition for shipment to the Colony from the port of shipment in the country from which the same were directly or indirectly imported.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

2,764. "Lighting equipment for motor cars." W. C. Fairweather (Rae). February 26th.

2,779. "Electric heaters for use with internal-combustion engines, &c." Falkirk Iron Co. & C. G. Nobbs. February 26th.

2,785. "Electric lift system." Otis Elevator Co. & Waygood-Otis, Ltd. February 26th.

2,788. "Apparatus producing or utilising electrical oscillations." W. H. Wilson. February 26th.

2,802. "Telephone system." B. Asserson & H. J. Carter. February 26th.

2,807. "Electric furnaces." J. O. Boving. February 26th.

2,838. "Primary batteries." M. Bonora. February 26th.

2,851. "Electrolytic process to recover metal from scraps." E. Popper. February 27th.

2,865. "Electric water heater." E. C. Webster. February 27th.

2,874. "Receivers for wireless telegraphy." O. D. Lucas. February 27th.

2,878. "Processes for heating, melting, and annealing metals by electricity." H. Alexander, A. Imbrey & W. T. Vint. February 27th.

2,890. "System of telephony." L. Mazza. February 27th.

2,895. "Ignition systems for internal-combustion engines." Philips Brinton Co. February 27th. (U.S.A., March 23rd, 1916.)

2,900. "Electric cable connectors." Chloride Electrical Storage Co. and H. Dean. February 27th.

2,903. "Excess wattmeters." A. W. Burke. February 27th. (U.S.A., February 24th, 1916.)

2,907. "Portable electric lamp." A. Fletcher. February 27th.

2,912. "Mercury rectifier distributing systems." British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.) February 27th.

2,991. "Spark plugs." A. L. Riggs. February 28th.

3,012. "Sparking plugs for internal-combustion engines." C. F. L. King. March 1st.

3,039. "Wireless radio-signalling by the arc system." L. Cohen. March 1st.

3,044. "Electric switches for handlamps, &c." J. G. Ellis. March 1st.

3,046. "Drawn filaments for electric incandescence lamps." P. F. Guardicla. March 1st.

3,061. "Lifting magnets." A. H. Curtis & Igranic Electric Co. March 1st.

3,062. "Resistance grids." A. H. Curtis & Igranic Electric Co. March 1st.

3,091. "Carrier for supporting electric lamp, &c., shades, reflectors, &c." A. P. Rutherford. March 2nd.

3,102. "Holders or adapters for carbons of electric arc lamps." N. Eales and T. L. Grimstone. March 2nd.

3,113. "Manufacture of carbon for electrochemical, metallurgical, &c., services." T. W. S. Hutchins. March 2nd.

3,125. "Apparatus for electrolytic production of copper, &c." M. V. Garin (née Bailly). March 2nd.

3,127. "Electromagnetic switches or contactors." A. West & Co. and W. L. Wise. March 2nd.

3,128. "Electromagnetic switches or contactors." F. N. Pickett and A. West & Co. March 2nd.

3,131. "Electric ignition systems for internal-combustion engines." Etablissements de Dion-Bouton Soc. Anon. March 2nd. (France, April 22nd, 1916.)

3,155. "Electrical generators and motors." J. Shepherd. March 3rd.

3,160. "Manufacture of clay, lumbago, &c., articles by electro-deposition on metal moulds." B. J. Allen. March 3rd.

3,179. "Sparking plugs for internal-combustion engines." G. Parsons and T. C. E. Rowland. March 3rd.

PUBLISHED SPECIFICATIONS.

1915.

10,226. Interconnecting the Electrical Conductors of Two Railway Cars. J. Wollenmann. July 14th.

1916.

The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

88. Apparatus for Concentrating and Projecting Radiant Energy. S. Salto. January 3rd, 1916. (103,830.)

224. Driving and Controlling Dynamo-electric Generators. W. F. W. Rhodes & J. Firth. May 22nd, 1916. (103,835.)

1,705. Means and Apparatus for Controlling Alternating Currents such as are used in Wireless Signalling Systems. British Thomson-Houston Co. (General Electric Co., U.S.A.) February 4th, 1916. (103,842.)

1,843. Alarm Thermometers. E. Gethin. February 8th, 1916. (103,848.)

2,249. Means for Passing Through the Human Body Currents Derived from the Ordinary Town Main Electric Supply. E. E. Greville. February 15th. (Cognate applications, 8,240/16 and 11,363/16.) (103,859.)

2,288. Massage Apparatus. J. C. Johansen. February 15th, 1916. (103,863.)

2,329. Means for Producing Alternating Currents. British Thomson-Houston Co. (General Electric Co., U.S.A.). February 16th, 1916. (103,865.)

2,350. Electric Pocket Lamps. A. Weinmann & E. Kuhn-Frei. February 16th, 1916. (103,871.)

2,524. Method of and Apparatus for Transforming Motion into Electrical Waves or Impulses. T. B. Dixon. July 19th, 1915. (100,940.)

2,546. Electrically-operated Valves. E. C. St. John. February 21st, 1916. (103,879.)

2,580. Telephone Systems. Relay Automatic Telephone Co. & H. J. Herink. February 21st, 1916. Addition to 102,330. (103,880.)

2,956. Railway Signals. W. H. I. Welch. February 28th, 1916. (103,888.)

3,028. Combined Lamp and Shade Holder. A. A. Thornton (T. Shepherd). February 29th, 1916. (103,889.)

5,570. Storage Batteries. W. A. Crowdus. April 22nd, 1915. (100,315.)

5,777. Electrically-operated Friction Hoists. J. Scott. April 20th, 1916. (103,914.)

8,792. Construction of Electromagnet for Localising Foreign Substances which have become Embedded in the Human Body. A. J. Bergonie. June 22nd, 1915. Addition to 9,623/15. (100,746.)

10,100. Circuit-interrupting Devices. British Westinghouse Electric and Manufacturing Co. (Westinghouse Electric & Manufacturing Co., U.S.A.). July 18th, 1916. (103,947.)

10,973. Control Mechanism for the Doors of Lifts. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.). August 3rd, 1916. (103,949.)

11,267. Apparatus for Medical Treatment by Electricity. L. Mayor. September 25th, 1915. (101,625.)

11,358. Automatic Selecting Devices for Telephone Systems. Siemens and Halske Akt. Ges. August 11th, 1916. Addition to 23,336/13. (103,952.)

12,351. Regenerative Braking Systems for Electrically-driven Vehicles. W. V. Turner & T. H. Thomas. February 5th, 1916. (103,959.)

14,666. Impulse Transmission Dials, and chiefly those used in Automatic or Semi-automatic Telephones. S. Simpson. October 16th, 1916. (103,970.)

16,457. Light Reflectors for use in High-speed Submarine Cable Telegraphy. T. B. Dixon. July 19th, 1915. (102,964.)